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Table of contents

Session 1 - Data quality issues in Ocean science

Oral presentations

Rolling Deck to Repository (R2R): Automating Quality Assessment Across the US Research Fleet

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The Rolling Deck to Repository (R2R) project was launched in 2008 to systematically assess and preserve routine underway data from all vessels in the US academic research fleet (http://www.rvdata.us). This will involve more than 30 vessels, large and small, from 18 independent operating institutions, with a wide range of data practices, computer systems, naming conventions and digital media, for a total of about 500 research cruises per year. During the prototype phase and initial year of the project, 15 vessels submitted data from 1053 cruises, for a total of more than 3.7 million files. A series of related IMDIS 2010 presentations by Carbotte, Clark, Chandler and Smith will provide an overview of the R2R project and details on dataflow strategies and other issues. Here, we focus on plans for data quality assessment as part of R2R.

In recent years there has been a change in the cultural patterns in the marine science and other communities. Data are being exchanged, and re-used, more than ever. Much of the re-use is accomplished without the direct involvement of the original data collector. Whereas “in the old days” you used to go to sea, collect your own data, work it up, publish it and then exchange reprints, it is now a general practice to combine data from various online resources even before you go to sea, and to submit your data to a repository for others to use after returning. As a result, we all need to pay more attention to responsible data preservation, including an awareness of provenance and quality of the original data.

R2R activities will span three phases, 1) initial bulk deep archiving, 2) extraction of selected data sets and metadata, and 3) migration of data sets and supporting information to existing national repositories, in accord with any proprietary hold requirements. The US national repositories, including the National Geophysical Data Center (NGDC) and the National Oceanographic Data Center (NODC), have the mandate of providing long-term end-user access to the scientific community and the public. Routine and timely R2R assessment of data quality will provide feedback to ship operators, ensuring that the highest quality data are consistently acquired.

As a basic first step in preservation, R2R will take responsibility for deep archiving the entire raw shipboard data distribution for each cruise, as provided by each operating institution. R2R will perform routine quality assessment during the second phase, with metadata harvested from the selected data files that are extracted from the bulk distributions. High demand data types such as navigation will be fully quality controlled, not just quality assessed. At the present time, the community of shipboard operators have adopted the following routine underway data types: ADCP, CTD, echosounder, expendable probe, fluorometer, gravimeter, magnetometer, meteorology station, multibeam, navigation and pCO2, SSV, subbottom, TSG, and winch.

With today's budget realities, the only hope of accomplishing these archiving tasks will be to scale up with extremely efficient staging, harvesting and dissemination techniques, almost entirely eliminating manual effort. Automating the process across the entire fleet with hundreds of cruises per year will be a challenging task, not only because of the sheer volume of data, but perhaps more so due to the diversity in data practices and formats, and the fact that at present very little quality information is routinely collected during US shipboard operations.

Building upon successful efforts with other projects, automated processing scripts will identify and extract the routine underway data sets from each bulk cruise distribution. Once the files are extracted for each data set, additional processing scripts will harvest necessary metadata information from the data files themselves and store the results in databases, enabling other scripts to assess quality, automatically identify problems and perform workflow operations. For example, public domain MB-System software can provide standard ASCII info files that can be harvested by scripts for a number of parameters helpful for quality assessment and georeferencing, for virtually any swath mapping bathymetric sonar system. For flexibility, metadata for each file, dataset and cruise will be maintained in a database, for use by processing scripts and web services. For scalability and extensibility, database-enabled processing scripts will make use of community-approved controlled vocabularies for instrument characterization, provenance tracking and quality assessment.

As an approach to the troublesome problem of tracking quality and provenance information throughout the data lifecycle, from shipboard acquisition, through various processing centers, and on to final archives, we propose to introduce an R2R Quality Assessment Certificate that will travel with the data. During staging, the Certificate can be created from metadata for each data file and cruise, and distilled and aggregated as need for files or datasets that will be migrated out of R2R holdings and on to national repositories. Our current design for an XML Quality Assessment Certificate involves 7 fields: assessment category ("quality" or "provenance"), assessment event (e.g., a step in processing, or a quality test, selected from a controlled vocabulary), assessment event date, identity (name of the individual making the assessment), institution (where assessment made), result (outcome of the assessment event, from a controlled vocabulary), and comments (free text to describe the assessment). By constraining fields of the certificate to controlled vocabularies we can manage growth as wider varieties of data types and assessment events are developed, and can avoid some of the confusion in terminology introduced arbitrarily by contributors in various disciplines when a common term would do just as well.

During and after the IMDIS conference we would like to encourage a dialog between US and European participants to encourage interoperability, based on an understanding of procedures, automation tools, quality criteria, metadata elements, and controlled vocabularies. Funding for the five-year multi-institutional R2R program comes from the US National Science Foundation (NSF) Oceanographic Instrumentation and Technical Services Program.

Quality control of oceanographic data with the Sea of Azov database being exemplified

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In the present work, systematization techniques of oceanographic information developed by specialists from MMBI KSC RAS, SSC RAS and NOAA within the framework of the Project “Global Oceanographic Data Archaeology and Rescue” (GODAR) are adapted to conditions of southern inland seas.

The database of the Sea of Azov presents a unique mega-base of primary data, which covers more than 133 000 stations and 120 years of observations throughout the entire sea area. The number of sea observations exceeds 40 000 stations. The archival base comprises historical data from Marine Hydrological Year-Books of 1946–1968, Proceedings of the Azov–Black Sea Scientific–Fishery Expedition, and other offshore cruises in the last century. Our database also comprises primary information obtained for the decade of 1997–2007 by specialists from MMBI KSC RAS and SSC RAS with the use of state-of-the-art methods on board the R/Vs Professor Panov and Deneb. Information in database is stored as “in situ” expeditions that extended opportunities of control and complex analysis of simultaneously received diverse data. The database was developed with the account that quality control should be continuous, all-round and complex. The only way to achieve this is permanent use of the database when deciding scientific problems.

In SSC RAS, a two-step quality control system was developed: preliminary - by administrator of a database and automatic - by data import program. Data quality control by database administrator was carried out according to the pattern approved by the NOAA Ocean Climate Laboratory. First, gross errors in primary data were determined and corrected. For example, coordinates of a station are on the shore, time interval between two successively made stations does not coordinate with a possible speed of a vessel’s motion, etc. Regularities of annual climatic cycle of temperature and salinity variation for the Sea of Azov were considered at the second stage of the data quality control to determine the range of allowable values for these parameters.

The feature of historical data is presence of the out-of-date or forgotten techniques of definition of physical and chemical parameters of seawater. Therefore, the structure of the quality control procedures should include the analysis of calculation methods (for example, methods of salinity definition). Before the researchers acquired CTD-probes at their disposal, the Sea of Azov salinity was calculated by chlorinity values.

It is known for the N.M. Knipovich expedition of 1922-1927 that salinity values were calculated by the Knudsen tables (for the seawater), thus obviously leading to an error (of unknown value) and the fresher the water, the graver the error. It is quite probable that L. Antonov (data of 1913-1914) also used the Knudson tables.

It is also known that for Marine Year-Books of 1947-1956 (Part 2 – Sea Observations), when calculating the Sea of Azov water salinity, the following formula was applied:
$S=1.794 *CL+0.21$, (1)
where S – salinity, ‰, CL – content of ions of chlorine, ‰,
and for the Kerch Strait, the Oceanological Tables of 1940 were applied (author: N.N. Zubov).

For Marine Year-Books of 1957-1960 (Part 2 – Sea Observations), it is known that salinity was calculated according to the GOIN Methods Guidelines (formula developed by A.P. Tsurikova).
$S=0.0294 * CL2 + 1.664*CL + 0.263$, with $1 ‰ < CL < 4 ‰$, (2)

S=1.792*CL + 0.23, with CL >= 4 ‰. (3)

Apparently, when calculating salinity by chlorinity after 1960 oceanographic tables, calculated according to the formulae developed by A.P. Tsurikova, were applied. At the same time, there are no references to the formulae used in some publications, the primary information of which was included into the database.

SSC RAS and MMBI, when calculating salinity by chlorinity for the Sea of Azov, apply formulae (2)-(3).

To determine possible errors in the tables of primary data salinity calculation and correlation with primary information were made by formulae (2)-(3).

Values, exceeding the allowable limits of parameters' variation, were not included into the database.

Important elements of the technology are as follows: a special interface for base formation, programs for quality control and duplicate omission, and user's interfaces for sampling, applied scientific analysis, and comparison of diverse. During import a set of checks are executed: presence of parameters of information binding (for expedition – start and end dates, ship; for station – geographical coordinates and date; for measurements – units); correspondence of numerical values to boundary conditions; duplicate check. At diagnosing mistakes and impossibility to define the correct value, obvious mistakes are excluded, and to doubtful values the corresponding quality code is added.

Automation of database formation and use allows creating on its basis other products, for example, the climatic atlas of the Sea of Azov. The key element of oceanographic database development is formalization of procedures of the description of the primary information and the data quality control. Today the oceanographic database of the Sea of Azov is in open access on the NOAA official site http://www.nodc.noaa.gov/OC5/AZOV2008/start.html.

Outcome of IODE's first workshop on the Quality Control and Quality Assurance of Chemical Oceanographic Data Collections, Ostend, Belgium, 8-11 February 2010.

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The first IODE workshop on the Quality Control and Quality Assurance of Chemical Oceanographic Data Collections was held in Ostend, Belgium on 8-11 February 2010. The workshop is part of an initiative from the IODE's Group of Experts on Biological and Chemical Data Management and Exchange Practices (GE-BICH) to provide better guidelines for the QC and data reporting of chemical and biological data. Some 20 experts in the QA/QC and management of chemical oceanographic data were selected to participate to this first workshop. The workshop's main objective was to evaluate existing procedures and recommend a minimum set of data quality control and reporting procedures for chemical data collections held at data centres and oceanographic institutions, focusing in a first instance on dissolved inorganic nutrients and dissolved oxygen from discrete water samples. Using these variables as examples, we focused on four main areas: quality control checks and procedures, common quality control issues, QC flags schemes and strategy, units and metadata requirements for data reporting and exchange. This presentation will give an overview of the outcome from the workshop, highlight synergies with other international initiatives and present issues that we feel would need to be addressed in the future. We also invite international collaboration via our wiki (http://sites.google.com/site/gebichwiki/).

A Prototype Database and Web Portal for Comparing Argo Delayed Mode QC with that of Operational Centres

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There is a common perception that in-situ observations record the true state of the Earth system, and that models should be compared to this truth. However, there are many possible sources of error in the values recorded by in-situ instruments, and this needs to be carefully assessed and quantified.

The argo programme has systems in place to handle quality control including detailed assessment of possible errors in the data via its delayed mode QC. However, this process currently takes a number of months or even years due to the methods requiring at least 6 months data and a lack of resources in some data centres: thus making it unsuitable for operational centres. These centres employ their own checks on the data in a less detailed but shorter process.

We undertook a study to compare the outcome of argo delayed mode QC with that of a number of operational centres. The ability to carry out this work was greatly enhanced by the efforts of the Godae project (1). A relational database of QC decisions was developed with a web portal front end to enable users to search for and view QC data of interest. The system contains data from two sources which have been matched and inserted into the database. One dataset is from the GODAE project (1) which has gathered QC decisions from a number of operational centres, and the other dataset consists of the argo delayed mode data downloaded direct from the GDAC.

We have used a postgreSQL database with postGIS and GEOS to enable geospatial capability and searching within polygons. The good java support for postgreSQL was found to complement the developement of the related java web application which handles requests from the web interface.

Users can choose to filter their search by outcome of the argo delayed mode QC process and/or by the decisions made by the centres to accept or reject the argo data. The geographical area, and the time window of the search can also be tailored by the user.

For example one may ask the question "within the North Atlantic in 2007, show me all the argo floats which (having undergone delayed mode QC) were assessed as comprising less than 50% good data, but which were accepted by the UK Met Office and FNMOC Operational centres". The results of such a query are displayed on the map, and some basic statistics are given alongside.

As part of this project meetings have been organised between operational centres, and staff involved in argo delayed mode QC, as well as those developing ocean reanalyses. One key result from these meetings has been the awareness of the need for a historical greylist of argo floats. This knowledge can greatly help those involved in ocean reanalyses by detailing which floats were greylisted at times in the past. Currently argo floats are taken off the greylist when they are withdrawn from service.

Here we will present results which reveal some interesting trends in the QC data. For example there are significant numbers of profiles accepted by the centres which delayed mode QC later deemed to comprise mostly bad data. This trend was not constant across the centres. In this presentation we will discuss these initial findings, and give our thoughts on the future directions of the project.

(1) see Cummings et al, "GODAE ocean data quality control intercomparison project", community white paper, Ocean Obs 2009

U.S. Quality Assurance of Real-Time Ocean Data (QARTOD)

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High-quality, long-term observations of the global environment are essential for understanding the Earth's environment and its variability. The United States contributes to the development and operation of many ocean observation systems – some of which have been in operation for many years. To ensure high quality of the large amount of ocean observations that will be available in the near future, systems must require more robust quality control and quality assurance procedures.

The Quality Assurance of Real-Time Oceanographic Data (QARTOD) group is a continuing, U.S. multi-organizational effort formed to address the quality assurance and quality control of oceanographic data collected by the Integrated Ocean Observing System (IOOS) community. Five workshops have been held at various locations in the U.S. (QARTOD.org) averaging over 60 participants from federal agencies, universities, oceanographic institutions and private industry , focusing on the primary task of developing minimum standards for calibration, quality assurance (QA) and quality control (QC) methods, and metadata.

QARTOD developed seven monumental standards for an ocean community struggling to understand the challenges related to the distribution and description of data from the Integrated Ocean Observing System (IOOS). First, every real-time observation distributed to the ocean community must be accompanied by a quality descriptor (Was the data quality controlled? Was the data quality questionable?). Second, all observations should be subject to some level of automated real-time quality testing. Third, quality flags and quality test descriptions must be sufficiently described in the accompanying metadata. Fourth, observers should independently verify or calibrate a sensor before deployment. Fifth, observers should describe their method of verification/calibration in the real-time metadata. Sixth, observers should quantify the level of calibration accuracy and the associated expected error bounds. Finally, manual checks on the automated procedures, the real-time data collected, and the status of the observing system must be provided by the observer on a time-scale appropriate to ensure the integrity of the observing system. Though the primary focus of QARTOD is on real-time QA/QC, it was understood that some methods and requirements for the real-time data are easily extendable to "delayed mode" QA/QC and that the real-time and retrospective processing are both linked and ultimately required.

Extending QARTOD to an international body will require a concerted effort between nations participating in the Global Earth Observing System of Systems (GEOSS). The Intergovermental Oceanographic Commission (IOC) must provide governance and organizational structure/support. An international Data Management and Communication (DMAC) organization will need to be assigned the role of validating and approving QA techniques and QC algorithms. Nations will need to provide funding and travel for participants to attend meetings, write reports and develop/transition algorithms. Finally, ocean sensor technicians will need to work closely with their data management counterparts to ensure required sensor and platform metadata are accurately and completely provided. The U.S. QARTOD effort, the WMO/IOC WIGOS effort and related efforts like EuroGOOS ISO9001:2000 implementation are excellent first steps towards coordinated international quality control and assurance.

SeaDataNet standards for quality control

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SeaDataNet Partners:

IFREMER (France), MARIS (Netherlands), HCMR/HNODC (Greece), ULg (Belgium), OGS (Italy),NERC/BODC (UK), BSH/DOD (Germany), SMHI (Sweden), IEO (Spain), RIHMI/WDC (Russia), IOC (International), ENEA (Italy), INGV (Italy), METU (Turkey), CLS (France), AWI (Germany), IMR (Norway), NERI (Denmark), ICES (International), EC-DG JRC (International), MI (Ireland), IHPT (Portugal), RIKZ (Netherlands), RBINS/MUMM (Belgium), VLIZ (Belgium), MRI (Iceland), FMI (Finland), IMGW (Poland), MSI (Estonia), IAE/UL (Latvia), CMR (Lithuania), SIO/RAS (Russia), MHI/DMIST (Ukraine), IO/BAS (Bulgaria), NIMRD (Romania), TSU (Georgia), INRH (Morocco), IOF (Croatia), PUT (Albania), NIB (Slovenia), UoM (Malta), OC/UCY (Cyprus), IOLR (Israel), NCSR/NCMS (Lebanon), CNR-ISAC (Italy), ENSSMAL (Algeria), INSTM (Tunisia)

The Earth's natural systems are complex environments in which research is difficult in most instances and where many natural factors and events need to be taken into consideration. Especially complex are the aquatic environments which have specific research obstacles to overcome, namely deep, dark and often turbulent conditions. Good quality research depends on good quality data and good quality data depends on good quality control methods. Data can be considered 'trustworthy' after thorough processing methods have been carried out. At this stage they can be incorporated into databases or distributed to users via national or international exchange.

Quality control, if done well, brings about a number of key advantages including maintaining standards, consistency and reliability. To develop the SeaDataNet quality control procedures, information has been extracted from many existing documents and manuals from international, national and individual organisational programmes and practices, building on existing expertise and good practice to develop and enhance procedures. Links have also been developed with other projects and programmes including, for example, the IOC/IODE-JCOMM Ocean Data Standards Pilot Project, ICES Working Group on Data and Information Management and the EU FP7 MyOcean project.

Quality control includes basic automatic checks which can be applied to almost all data types (e.g. biological, chemical, physical and geological/geophysical data), often in near-real-time. In addition, a more scientific level of quality control is carried out tailored to the type of data, often including visual inspection.

For all types of data information is required about:

- Where the data were collected: location (preferably as latitude and longitude) and depth/height
- When the data were collected (date and time in UTC or clearly specified local time zone)
- How the data were collected (e.g. sampling methods, instrument types, analytical techniques)
- How the data are referenced (e.g. station numbers, cast numbers)
- Who collected the data, including name and institution of the data originator(s) and the principal investigator
- What data were collected (e.g. parameters should be properly defined)
- What has been done to the data (e.g. details of processing and calibrations applied, algorithms used to compute derived parameters)
- Comments for other users of the data (e.g. problems encountered and comments on data quality including the results of automatic quality control tests)

This information must be stored alongside, and made available with, the data. This will ensure that data supplied to national and international data centres are consistent, and of a known accuracy, allowing future researchers to better define confidence limits when applying these data.

Building SensorML Systems for Describing Ocean Observing Systems

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Long-term, nearly continuous sampling capabilities are evolving in parallel with technologies enabling the acquisition and analysis of these data in near real-time. In order to assure sustained value in these new observational opportunities, methods of documenting data sources and lineage must also mature and develop through standards-based, community adopted frameworks. Through recent developments in international standards groups such as the W3C and OGC, frameworks are being developed and adopted throughout the geo-spatial community. We now stand at a cross-road in how we look at data discovery and delivery. Historically, disparate projects collected data and archival was up to the data collector. Now, as the semantic web enables meaningful searching and the development of relationships amongst disparate sources of information, national and international centers will be able to aggregate data, when encoded with sufficient information (metadata) to fully describe and evaluate the discovered data. This can remove the onus on the small data provider to have knowledge of the larger programs that may benefit from their data. With the development of an oceanographic set of tools and well-defined expectations in metadata, any data provider should be able to publish data to the WWW into a community that may have needs and visions far beyond the purpose of the original project. This capability adds value to any data collection beyond temporal, geo-spatial and disciplinary boundaries.
In this paper, we will present examples of implementation of SensorML in support of web services, describing document electronic specification sheets, lineage and provenance of data sets, and archival of system parameters for marine applications.

Posters

Computing reference profiles of fluorescence to validate historical and incoming data

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In recent decades, some optical sensors have been installed in CTDs and current meters devices, so some optical parameters measurements as fluorescence, turbidity, light has been performed, mainly as a reference to chlorophyll or for any other biological parameters indicators. Furthermore, for the first cruises in which only CTD with fluorescence sensor installed were deployed and not water samples were taken, nobody during the cruise was responsible for these parameters; so many optical data that are archived in the Data Center are not properly validated.

In general, the data integration in regional and global databases requires a significant effort in codes and units standardization, as well as quality control of the incoming data. In the case of this type of parameters, due to the few data and the large variability, more difficulties appear to the oceanographic data managers to perform a good quality control. In fact, only the spikes and broad range checks have been applied to the archived data.

The motivation of this study is to get tools to perform a quality assurance of the optical parameter in general but for the moment focused only in the fluorescence.

Annual and/or seasonal averaged profiles will be computed from the whole data set in different oceanographic regions o sub-regions depending on the volume of data. Once the reference profiles have been obtained, in a first approach, a visual cross-check with each original profile is performed to validate the data and assign them the corresponding quality flags. The process will take place twice or three times using each time only data flagged as good, in order to get a more reliable statistic values and consequently a better data validation.

The first step to compute the statistics is to interpolate each profile at standard levels and then obtain the mean and standard deviation for each level of the selected region or sub-region applying the winsorized method.

Moreover, since there are available fluorescence data from an underway thermosalinograph installed in the ‘Cornide de Saavedra’ ship, annual and seasonal spatial distribution of the fluorescence at surface will be also computed, that will help to improve the statistics obtained at surface from the profiles data set.

Data Synthesis and Quality Control of Carbon and Relevant Chemical Parameters in the Pacific Ocean

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Hydrographic data including ocean carbon and relevant chemical parameters in the Pacific Ocean were collected and merged to a new database which is called PACIFICA (PACIFIc CArbon). These data were submitted from one time and repeat hydrographic and time series programme by PICES (North Pacific Marine Science Organization) member countries since 1990. All PACIFICA data are in WHP (WOCE Hydrographic Program) exchange format and assigned the EXPOCODE, unique cruise identification consists of country code, ship code and date of cruise or observation start. At first primary quality control was processed to identify outliers and errors obviously using range, inversion and gradient check in each parameters based on the same method of World Ocean Database. These erroneous were either flagged as acceptable (2), questionable (3) or bad (4), or revised by way of direct contact with the principal investigator of cruises or data originator. In addition secondary quality control which was developed and applied to CARINA (CARbon IN the Atlantic) database was also processed to evaluate systematic biases involved in cruise data. Crossover analysis is a first step of the secondary quality control procedures and derives offsets and standard deviations as the statistically difference between two cruises of PACIFICA and GLODAP (Global Ocean Data Analysis Project) database. The crossover analysis identified more than 4000 individual crossovers for two databases, and performed on pressure, density (sigma-4) and potential temperature spaces in the deeper water. A next step of the secondary quality control procedures is inversions, the calculation of corrections of the parameters measured on individual cruises using least square methods with the offsets and standard deviations derived from the crossover analysis, and finally the adjustment table was determined by a second crossover analysis and inversion and any significant adjustments larger than threshold of parameters were scrutinized again by the experts. After adjustments, weighted mean absolute offsets improved 1.75 micro-mol/kg for total alkalinity, 1.64 micro-mol/kg for dissolved inorganic carbon, 0.42% for nitrate, 0.59 % for oxygen, 1.04% for phosphate and 1.36% for silicate. The results would be merged and updated to GLODAP data products and provided to scientific work such as study of ocean acidification and global warming.

Integrated data management onboard R/V Aranda

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A modern research ship is a versatile but slowly moving instrument that should be used as efficiently as possible. There is hardly any time to be wasted on the sea. The scientific crew has to be aware of data flows in real time onboard and of the ongoing processes in the sea. The relevance of the newly collected data should be immediately seen against all the existing data from the area. The cruise plan has to be easily adjusted to prevailing conditions and to observed data still maintaining the scientific objectives of the cruise. An integrated system makes this possible and gives ways to report some of the results of the cruise in real-time as well.

The scientific data management system of R/V Aranda has been planned to be highly automated. It is an integrated system covering processes from the first steps of the cruise planning up to the cruise reporting.

The cruise planning software, MyCruise, uses common station dictionary and data on territorial and economic zone boundaries. It produces a cruise plan in XML format. This XML file is the interface among cruise planning, laboratory system (ArandaLIMS), information channel onboard, cruise's near real-time Internet information and cruise reporting. The plan is continuously updated with MyCruise and LIMS-system. The final version of the plan is the basis of the cruise report generator of MyCruise.

Navigation and weather station data is automatically stored in AWC (Aranda Weather Channel) database with high frequency. This guarantees that all other observed parameters are easily geotagged. Oceanographic data from different sources are collected mainly into the ArandaLIMS that maintains the accredited quality system onboard.

All scientific data excluding weather data is uploaded into scientific database SUMPPU. The scientist's desktop tool (SDT) is the dynamic viewing interface to this database. It allows multiple dynamically linked views to the data simultaneously. Thus the newly collected data can be analyzed with the old data already during the cruise.

The ability to analyze data onboard, the local TV information channel and Aranda Wiki offer the personnel lots of information on the progress of the cruise.

Observed data including the route of the cruise is transferred daily via GSM or satellite communications to the respective databases on land. Aranda Internet pages (http://www.itameriportaali.fi/en/aranda/) can easily be kept updated with the help of these databases in near real-time.

The integrated data management system streamlines all scientific processes related to the research cruise. This ensures the quality of the work onboard and assures data consistency and quality. It saves workload and increases the efficiency of the use of the ship.

Global Sea Level Observing System (GLOSS) standardised quality control of sea level observations

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The Global Sea Level Observing System (GLOSS) is an international programme conducted under the auspices of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the World Meteorological Organisation (WMO) and the Intergovernmental Oceanographic Commission (IOC). GLOSS aims at the establishment of high quality global and regional sea level networks for application to climate, oceanographic and coastal sea level research. The main component of GLOSS is the 'Global Core Network' (GCN) of approximately 300 sea level stations around the world for long term climate change and oceanographic sea level monitoring. The Core Network is designed to provide an approximately evenly-distributed sampling of global coastal sea level variations.

One of the main functions of GLOSS is to provide for the smooth flow of sea level data from gauges together with associated metadata, to national and international centres, and to provide efficient and seamless access to the data for scientists and others.

Information relating to quality control of tide gauge data has been included in the IOC Manuals on Sea Level Measurement and Interpretation (Volumes I - IV), but now for the first time that detailed information on quality control procedures and agreed filtering techniques has been assembled into one document, the GLOSS Sea Level Quality Control Manual. Data from many countries are contributed to GLOSS - and in particular to the GLOSS Data Assembly Centres and the Permanent Service for Mean Sea Level (PSMSL). Thus it is beneficial to publish the current good practice and distribute the information widely in order that a more standardised approach can be realised. This will ensure that data supplied to the global sea level databanks are consistent, and of a known accuracy, allowing future researchers to better define confidence limits when applying these data.

The procedures include checking for unexpected anomalies in the time series, or in the derived tidal parameters, and in the filtering of the raw data to provide monthly mean values (which are submitted to the PSMSL which forms the basis of most climate-change related studies of sea level variations). But quality control extends beyond this. The documentation of datum information (e.g. relationship of the recorded sea levels to the level of benchmarks on land) is essential. Diagrams, maps and other metadata also must be provided. However, there is at present little standardisation of methods for consolidating and archiving such information. Quality control is also related to issues such as the availability of data in real-time. If data are inspected every day or, in advanced systems, if data can be flagged for errors by automatic software, then faults can be rapidly attended to and fixed.

The GLOSS Sea Level Quality Control Manual draws on existing documents such as the relevant IOC Manuals, ESEAS Quality Control Manual, the experience gained by the WOCE Sea Level Data Assembly Centres, other international programmes (e.g. IOC's International Oceanographic Data and Information Exchange (IODE) programme, JCOMM Data Management Programme Area (DMPA) and the International Council for the Exploration of the Sea's Working Group on Marine Data Management (ICES WGMDM)) and national expertise to derive a set of recommended standards for quality control of tide gauge data. This will result in data sets of sea level which have been acquired and processed to agreed standards and which have thereby obtained GLOSS quality endorsement.

Project RAIA. Towards a North Portugal - Galician Oceanographic Monitoring Network: Quality control data.

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The Galician coast (NW Iberian Peninsula coast) and mainly the Rias Baixas (southern Galician rias) are one of the most productive ecosystems in the world. In this context, the installation of real-time ocean-meteorological stations along the Galician Coast is a great improvement towards the monitoring of hydrographical conditions in this region.

Five years ago INTECMAR (Technological Institute for the Marine Monitoring of Galicia) that is in charge of water quality control for shellfish growing areas in Galicia and the meteorological agency from the government of Galicia (MeteoGalicia), in collaboration with the Group of Physical Oceanography of Universidad de Vigo, started the building of the Galician Oceanographic Network in the framework of EROCIPS and EASY projects financed by the EU through Interreg IIIB “Atlantic Area” Program. Nowadays this network has three platforms along the Galician Coast (Cortegada Islands, Cíes and Rande Bridge) that collect meteorological data (temperature, humidity and wind direction and intensity), and oceanographic data (salinity, temperature and currents direction and intensity at different depths). Data acquisition is via inductive cable to the data logger and continuously (each 10 minutes) sent via GPRS communications to the central server. Data dissemination is being done by MeteoGalicia (http://www.meteogalicia.es) and Intecmar (http://www.intecmar.org/plataformas) Web pages and distributed to IBIROOS data Centre through Puertos del Estado.

The present project RAIA (financed by the EU through the “Programa de cooperación transfronteriza España-Portugal) constitutes a great opportunity to improve this network. The main objective of RAIA project is to develop an oceanographic observatory for the Galicia and Northern Portugal coast in order to consolidate a cross-frontier oceanographic network in the Iberian Margin by improving the real-time monitoring of hydrographical conditions.

In the framework of RAIA, one of the actions is focused on Data Quality Control with the aim of developing protocols and common procedures to validate the oceanographic and meteorological data in the Iberian Margin. Moreover the increase in number of platforms deployed will allow the development of new control tests based on the spatial variability of data.

To assure the quality of oceanographic and meteorological data, an automatic quality control system was developed, gathering the Coriolis, ESEOO and Mersea guidelines. The data quality control is to check carefully all the data collected in each parameter (salinity, conductivity, temperature, water level, density, etc) to find the anomalous or bad data. Working on the raw time series data and based on the means of execution, our quality control program is divided into automated (labelled as Automatic QC) and manual (labelled as Manual QC) procedures control. A software tool was developed by MeteoGalicia in order to carry out the QC procedure in a friendly way and currently INTECMAR performs the manual QC in a routine way.

The Automatic QC uses four kinds of tests to examine a large amount of measurements and then the Manual QC is applied to the suspicious data identified by the AutoQC for further check. Based on the sequence of execution the automatic QC consists in:

• Physical range test, to require that the data observations should be possible. The data are tested against ranges derived from WOD98 appendixes and physical limitations of sensors.
• Historical range test, to detect and to sing as suspicious the data out of historical measurements in the studied area.
• Spike test, to detect and to sing as suspicious the anomalous spike and whenever it is possible to interpolation the bad data.
• Persistence test: To detect the systematic repetition by using Standard desviation.

Once the Automatic QC is finished all the data have assigned a quality flag, then the Manual QC is made by the operator on the suspicious data to validate ones and to reject others on the basis of their experience and knowledge, finally a definitive quality flag is assigned. End-users should read and use carefully those flags to be sure that only good quality data are used, guided by Coriolis control flag scale.

The increase in number of platforms deployed will allow the development of new control tests based on the spatial variability of data. Moreover, the development of an interoperability platform to disseminate all the collected data that is one of the challenges of RAIA Project, will improve the dissemination of these data. This platform will achieve three issues. First, it will be oriented to provide web services based on Inspire Directive and OGC services. Second, it will be the capability of merge several heterogeneous sources (mooring buoys, CTD profiles, HF radar fields, models outputs,…), and third, it will be an user-friendly platform since it will provide services to public/private institutions in order to assure the future sustainability of the network.

Operation and Data Management of the E1M3A integrated ocean observing system

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The in-situ, real-time, continuous and reliable monitoring of the marine environment is acknowledged as one of the most challenging procedures for operational oceanography. Moored sites seem to be the most appropriate platform for such an effort presenting however many difficulties in terms of maintenance, data transmission, data quality assurance etc. During last decade a network of open sea moored stations for continuous real-time measurements of physical and bio-chemical parameters in the subsurface and intermediate layers of the Mediterranean Sea, developed during MFSPP (1998-2001) and MFSTEP (2003-2006) projects. The three multi-parametric moored stations which also contributed to MERSEA (2007-2009) In Situ observing system, were the E1-M3A of the Cretan Sea (south Aegean) operated by HCMR, the E2-M3A of the south Adriatic Sea operated by OGS and the W1-M3A of the Ligurian Sea operated by CNR-ISSIA. These sites have been selected as representative of different hydrological regimes and where important processes, such as dense water formation, are taking place.

The E1M3A site has been deployed in a transitional area with complex hydrology where water masses formed in the Levantine, the Aegean Sea and the Adriatic Seas meet and interact with the water masses of the Western Mediterranean Sea that enter through the Sicily straits. The platform which has been upgraded recently through POSEIDON II project hosts a variety of different sensors measuring meteorological, physical and biochemical parameters. The buoy used at E1M3A site is a Seawatch-Wavescan type which is a multi-parametric instrumentation platform and suitable for deployment in deep offshore locations (Furgo OCEANOR www.oceanor.no).

The data transmission and control of E1M3A station utilizes a dual GSM/GPRS and INMARSAT-C satellite system. The transmission is near real time with a three hours cycle. The actual data collected by the station are saved locally inside a flash memory prior to transmission and remain there to be downloaded usually on every maintenance survey. Additionally the sensors used on this site are configured to store the measured data in the internal memory so that if acquisition system or the cable connecting the sensor to the acquisition system fails, the data can be recovered during the maintenance missions when the sensors are recovered. The transmitted data are collected at POSEIDON operational center where automatic near real time quality control checks are applied upon the timeseries on a daily basis. This analysis has been established during the previous European projects MFSTEP, MERSEA and is performed before data are archived and released as standard quality controlled daily products. After the first level of the data quality assurance, two types of daily files are produced, ASCII (Medatlas) and Binary (NetCDF), in order to contribute upon the integration of data streams inside International and European projects (OceanSITES, SEPRISE, MyOcean etc.). Finally data are stored in the POSEIDON data base to a normalized mysql database. Its design supported our demand for quick search and reliable results on the parameter values and their metadata. The table, that contains the data information, associates them with their metadata and a flag, which shows if the parameter has passed through a quality control process and serves quality checking purposes. In delayed mode a visual inspection of the data is also performed in a regular basis inherent with the maintenance of the sensors that takes place after every new deployment. The recovered sensors are checked in the laboratory of HCMR and raw data are extracted. In a regular basis a calibration process upon a set of sensors is taking place in the laboratories of HCMR's department in Crete. An additional observatory site (POSEIDON-Pylos) was deployed in the South-west of Ionian Sea and operates since 2007. E1M3A and the new site, which is also a multi-parametric instrumentation platform, are a part of EuroSITES network of open sea multi-sensor moored arrays which operates at European level and contributes to OcenaSITES global network of open sea Eulerian observatories (Petihakis et al. 2008).

Producing a meaningful visualization of confidence for marine digital datasets.

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Over the last decade the British Geological Survey has produced numerous digital datasets for the marine environment. Generation of these datasets using such a wide range of source data, presents different challenges to those applicable to onshore data. Data is derived from numerous equipment types, various organisations and covering varying ranges of density/resolution and relevance. This talk will outline the stepwise approach, from the simplistic to the complex, taken to produce a meaningful visualization of confidence for the interpretation of marine datasets. Our aim is to create a cohesive confidence statement that works in unison with the actual geological interpretation being produced.

Electronic posters

Data processing and quality control for the autonomous ocean moored profiler AQUALOG

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A moored profiler is a useful tool for multidisciplinary research of the variability of both biotic and abiotic parameters of the sea environment on time scales from a few hours to several months. It is possible to estimate short-period ocean variability and its impact on the generation of mixing on the basis of regular profiling during a sufficiently long period of time. Regular and homogeneous profiling aims at revealing climate signals at fixed locations in sea basins. To assess the dynamics of barotropic and baroclinic waves, eddies and wave-eddy structures and their role in water transfer and exchange, it is necessary to carry out simultaneous observations using a set of the profilers. In comparison with free drifting profiling floats, the moored profiler technology comes with less risk of instrument loss and facilitates technical services including the replacement of power battery and regular cleaning of sensors. The main advantages of a moored station are as follows a frequent acquisition of data on a real time basis and a safe deployment near continental slope.

A new moored profiler named Aqualog was designed in P.P. Shirshov Institute of Oceanology, Moscow during 2005 and 2009. The profiler is built to carry a load of modern oceanographic instruments. It moves down and up along a mooring line as a sea ‘lift’ carrying various instruments including the FSI Excell 2'' Micro CTD probe, the Nortek Aquadopp current meter, and the AANDERAA Oxygen Optode 4330F fast sensor. These instruments are high-precision, stable and rapid-response. When the carrier is moving with the speed of 0.1 m/s the profiles are measured with a vertical resolution of 0.05 m for pressure, conductivity and temperature, 0.6 m for the current speed and 0.8 m for the dissolved oxygen. The pay load of this sea elevator may also comprise of other environmental probes e.g., the fluorimeter and the turbidimeter. The profiler mooring line is made of stainless steel wire that allows the user to extend the maintenance period of the mooring system up to several months. The programmable hardware of the profiler allows the user to set an automatic operation algorithm (variable movement speed, time and period of profiling, etc.).
So far the typical depth range of Aqualog’s profiling was 5–700 m. A titanium instrument housing allows the maximum depth of profiling to reach 3000 m. Vertical speed can be set up within 0.1 and 0.3 m/s. The pay load consists of at least 3 probes. Weight in the air is 62 kg without sensors or up to 75 kg with the sensors. Start and stop by magnetic switch or as preprogrammed. LED indication of the system status. The total profiling distance is about 800 km in still waters for a profiler with a lithium battery pack. The Aqualog has enough resources to profile a water column in the programming regime during several months.

The Aqualog was successfully tested during the expeditions into the Black Seas in 2007-2009. By using the Aqualog new data was obtained concerning inertial oscillations, mesoscale variability, and vertical exchange in the coastal waters. In particular over the north-eastern Black Sea shelf, the depth of the seasonal thermocline, the vertical gradient of density driven by temperature distribution and the current velocity gradient in the thermocline as well as the vertical exchange coefficient, all are substantially modulated by inertial oscillations and mesoscale vortices.

The data obtained by Aqualog profiler online and offline was transferred to the data center in P.P. Shirshov Institute of Oceanology. In the data center, quality control was carried out to verify the following: all the data was in the regional parameter range, ascending and descending profile data variance remained within the predefined limits, pressure and density inversions were eliminated, spikes were tested, proper visual QC was obtained, and etc. The quality control check was more extensive as compared with that of the free drifting profiling float data.
The results of the pilot experiments have indicated that the autonomous profiling stations of the moored type have great potential for being the key technical means for regional marine environmental monitoring.

Deriving of oceanographic parameters ranges for the data quality control from the climatological frequency distribution

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The data quality assurance is greatly depends on the reliability and sensitivity of the numerical criteria being used within quality control (QC) procedures. The simplest and widely used QC procedure is the range check which includes the comparison of observed data with the predetermined extreme values. The quality of the data will be higher if the numerical criteria used for QC depend on space (geographic region), time (season) and depth. To obtain reliable and sensitive criteria the statistical analysis of available data is necessary. Accumulation of new data makes it possible regularly refine published ranges and to compute new values for the areas which had sparse data coverage before.
The whole data set accumulated in the RIHMI-WDC and combined with WOD2005 under the Oracle DBMS has been used to compute the frequency distributions of physical and chemical parameters. Validation procedure was applied to derive the global and local (for the seas around the Russia) depth dependent ranges of parameters. Validation procedure is iterative method which includes check of values creating long tail of frequency distribution and flagging them as erroneous, provided that comparing with original reports or with other nearest data makes it possible to treat them as outliers.
To manage and to use the ranges for automatic QC they are loaded into relational data base. The root table contains the list of parameters accompanied with attributes which indicate whether or not the ranges are prepared for different ocean and seas, depth and seasons. The ocean areas and seas are described as polygon figures which can be nested. This data model permits to load into the data base new ranges for the new parameters, for the new local areas or new seasons in a continuous and seamless manner.
The raw frequency distributions of physical and chemical parameters for the oceanic areas and seas are accessible through the web-site http://www.meteo.ru/mcd/eocedata.html. As the project on data quality control and flagging moves forward the more precise statistics will be obtained.

Quality control of sampling and measurements at field researches

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Introduction

The Black Sea data and information infrastructure is underway within EU funded projects Black Sea Scene, SeaDataNet, UPGrade Black Sea Scene. One of the main task is to determine the present quality of Black Sea datasets, managed by the regional partners, through inventory of Data Quality Control methods, comparison with EU standards and practices, and Data Quality Assessments at partners, and to harmonize the future quality of datasets by exploring and harmonizing common DQC and DQA methods. Preceding the execution of this task, the Black Sea partners will produce an overview of the nature of data and information within their databases (NA4). Following the DQC and DQA guidelines of NA3-2, the BSNG will execute a data quality assessment on the data & information within the databases of the partners, and being made accessible within the framework of the Black Sea SCENE project. There will be considered, among others:

- Accuracy: degree of agreement of individual measurements with an accepted reference value.
- Precision: degree of agreement among independent measurements of a quantity under specific conditions.
- Proficiency testing: methods of checking in situ and laboratory testing performance.
- Quality control sample: sample used either singly or in replicate, as appropriate, to monitor method performance characteristics.
- Quality manual: document stating the quality policy, quality system and quality practices within partner's organization.
- Quality system: organizational structure, responsibilities, procedures, processes and resources for implementing quality management.
- Certified reference material and reference standards.
- Suitable equipment and standards.
- Records of calibration.
- Reporting procedures.

Following the above mentioned the program of works on quality assurance and quality control (in accordance with "Quality Assurance Project Plan (QAPrP)) has been developed, including the types of the control samples prepared and researched at field works and the techniques of their preparation, carrying out of measurements of control samples and processing of results of measurement. All methods should contain standardized tests of results of quality control and determine the allowable QC criteria for each test. The present technique determines and specifies the composition of control samples, order of their selection, analysis and processing of results. The technique regulates the order of corresponding actions for field measurements of water quality. The technique was used in the framework of NATO project "South Caucasus River Monitoring" (sfp 977991 Project, 2002 – 2009) and may be used at multidisciplinary water quality researches.

Types, definitions and purpose of field control samples

There are established 4 types of field control samples within the framework of field measurements:

- Replicates – are carried out at the same time in the same place; they are used for the estimation of accuracy of individual results;
- Field blanks, provided that field blanks are of three types:
    - o Transport blank - A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened; it is used to document contamination caused by the laboratory conditions, transporting and field handling procedures;

o Transfer blank - A sample of analyte-free media which is subjected to all aspects of sampling and analysis excluding the contact with all samplers and apparatus; it is used for checking the possible contamination from the environment;

o Rinsate (Equipment) blank - A sample of analyte-free media which is subjected to all aspects of sampling and analysis including the contact with all samplers and apparatus; It is used to determine the quality of cleanliness of samplers and apparatus for sampling before sending them to the field site.

Preparation of control samples and carrying out their analysis

• Replicates: are carried out right after accomplishing the first (basic) measurements;

• Transport blank: is prepared in laboratory conditions a day before leaving for field expedition - the distilled water is selected in a container for samples; after delivery to the laboratory the container is opened and blank is subjected to the analysis on content of all investigated analytes;

• Transfer blank: is prepared from distilled water (from the same water used during the preparation of transport blank), which is filtered on the place of sampling, is poured into the container for samples; after delivery to the laboratory the container is opened and blank is subjected to the analysis on containing all the investigated analytes;

• Rinsate blank: is prepared on the site of sampling; after cleaning the sampler from pollution and before sampling, the filling of sampler with the distilled water is carried out, which afterwards is filtered, transported to the container for samples; after delivery to the laboratory the blank is subjected to the analysis on containing all the investigated analytes.

Replicates are carried out at each station; transfer blank, rinsate blank are prepare at each station. As for transport blank, it is prepared for each forwarding day. The analysis of transfer blank is carried out at unsatisfactory evaluations of the results of the analysis of rinsate blank, and the analysis of transport blank are conducted- at unsatisfactory evaluations of results of the analysis of transfer blank.

Processing of results of control sample analysis and tolerable limits

For each type of sample there are established the corresponding calculated parameters and criteria of satisfaction evaluation of measurement results.

For Replicates a relative percent of difference Pd is determined, that is calculated by the formula:

$$Pd = [(N1 - N2)/\{(N1 + N2)/2\}] \bullet 100\%,$$

where N1 and N2 - are the parameter values received during the first (basic) and replicate measurements, correspondingly. The tolerable limits for Pd at which the assessment is considered to be satisfactory: $|Pd| <= 2Sr$, where Sr – is relative standard deviation.

For Transport blank, Transfer blank, Rinsate blank Result Blank Rb is determined, calculated by the formula in accordance with:

$$Rb = A - N3,$$

where A equals to maximum value from three following values: 1) MDL (Method Detection Limit (MDL) is defined as the minimum concentration of substance that can be measured and reported with 99% of confidence that the analyte concentration is greater than zero and it is determined from analysis of a sample in a given matrix containing the analyte; 2) 0,05•Nn; 3) 0,05•N1, where Nn – represents a regulatory limit for that given analyte N1 and N3 – are corresponding to the values of analyte concentration in researched and blank samples. The tolerable limits for Result Blank at which the assessment is considered to be satisfactory: $Rb >= 0$.

Assessment of data reliability

According to the measurements of researched samples the results of measurements of control samples should be analyzed with allowance of their reliability.

• Replicates: results of measurements of water quality parameters are considered reliable if the results of replicates are satisfactory, and they are considered unreliable if the results of replicates by any parameter are unsatisfactory.

• Transfer Blank, Rinsate Blank: the results of measurements of researched samples are considered reliable if the assessments of measurement results of the corresponding control samples are satisfactory, and they are considered unreliable if the assessment of measurement result, at least, of one corresponding control sample is unsatisfactory.

• Transport Blank: as for these samples at calculating the comparison the minimal value of concentration of analyte is taken out of all results of measurement of all researched samples, then the assessment of reliability of results of measurements of corresponding researched samples is carried out in the following order:

- o if the assessment of the result of control sample is satisfactory, then clearly the assessment is satisfactory for all the other samples and the results of measurements of all samples appear to be reliable;
- o if the assessment of the result is unsatisfactory then the value of analyte concentration of corresponding sample is considered to be unsatisfactory; further, the assessment of the result for the value of concentration of researched sample with the following (according to growth) quantity is determined, and in case of satisfactory assessment of the result all remaining values of concentration are considered to be reliable; and in case of unsatisfactory assessment the value of analyte concentration of corresponding sample is considered as well unreliable, and the procedure of processing is repeated similarly for the next value of concentration, etc.

At reception of an unsatisfactory assessment on control sample for specification of the concrete reason, the special program is made on carrying out of such researches which will unequivocally allow establishing the reason (and, accordingly, to remove it).

Conclusion

The technique regulating some aspects of quality control of measurements at field analysis is developed. The techniques of preparation, carrying out of measurements and processing of results are described in accordance with the established types of control samples. The technique can be used in other programs and works on research of parameters of water quality.

Quality check software for oceanographical data

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The advanced data quality control software was developed in MHI NASU. It includes automatic and manual QC modules so it can be used both for primary and expert quality control. The last version of the software includes QC tests allowing to set quality flags for metadata and data.

The quality control software implements the following checks for metadata:

- duplicate cruises and profiles check;
- data and chronology check;
- ship velocity check;
- location check;
- sea depth check;
- observation depth check.

Duplicate cruises check. This is one of the most difficult kinds of checking. The duplicate check includes:

- check of the same ship name and cruise number;
- check of cruises with the same dates;
- visual check of superposed stations.

Check for duplicate profiles

- automatic check of the same station positions and date for the identical instrument (within 1 mile, 1 hour)
- visual check of the position maps of cruises
- visual check and comparing on the same plot.

If a user detects that two analyzed cruises are incomplete copies of the same one he can compare profiles of overlapping stations and recompose this cruise from complement parts.

Data and Chronology check

- The day must be between 1 and the number of days of the month.
- The month must be between 1 and 12
- The date and time of the profiles must be within the cruise duration.

Vessel speed between each two subsequent stations is calculated. If the speed is higher than permissible one for the given vessel (including the period of the station accomplishing) visual check should be done

The quality check software includes a high-resolution array of geographic coordinates of the Black and Mediterranean Seas coastlines. Location of any station is checked to be within the region based on this array. Also a user can load his own coordinate file.

The data sets of the Black and Mediterranean Seas depths based on GEBCO one minute gridded bathymetry data were prepared.

Depth given in metadata, and if it is absent the last sounding level, is checked. If there are any differences the visual control and correction should be done.

At the second step, after checking metadata, oceanographic data are checked.

Preparation for checking data and metadata is made for cruises and consists of several stages.

The first stage is selection of cruises for the QC procedure.

The second stage is selection of the QC procedure configuration. The QC tests and their parameters are defined at this stage.

The third and forth stages are selection of parameters and configuration of climatic data control. After all preparations the QC procedure is available both in manual and automatic modes.
Oceanographic data control includes:

- density inversion check(for hydrological data);
- spike check;
- climatic check.

Climatic checking includes:

- three and five standard deviations checking;
- checking of density at standard depths;
- checking of temperature and salinity on isopycnal surfaces.

Hydrological data are checked to detect density inversion. Users can determine a reasonable range of density inversion. Data that have not passed this check can be checked and corrected visually.
The procedure recommended by IOC is used to check spikes. In general the spike test requires visual validation.
Climatic characteristics (mean and Mean Standard Deviation) for different squares of the Black and Mediterranean Seas for each month were prepared. The Climatic sub-regions for the Black Sea are 40x60 minute (40x40 mile) squares accepted by Hydro-Meteorological Service of Ukraine. Spatial variability of oceanographic parameters was also taken into consideration.
Some squares with considerable spatial variability were divided into 4 parts and climatic characteristics were calculated for each of them.
The climatic characteristics were calculated for 19 standard depths.
Time resolution was monthly from the surface down to 300 m and annual below.
The Mediterranean Sea sub-regions were taken as in the MEDAR/MEDATLAS II project.
The SeaDataNet quality flags scheme (L201 vocabulary) is used in our QC procedures.

The range method is used for some hydrochemical parameters with small amount of observations because it is difficult to obtain climatic estimations in this case. The ranges were taken from MEDAR/MEDATLAS II and corrected for the Black Sea. The last version of the software allows to update climatic arrays and ranges and to load the new ones.
Oceanographic data quality check software provides:

- both automatic and visual metadata check;
- both automatic and visual oceanographic data check;
- ability of metadata and data values correction at each step of the quality check procedure.

Its main features are the use of

- high quality climatic arrays for temperature, salinity and some hydrochemical parameters in the Black and Mediterranean Seas;
- data sets of the Black and Mediterranean Sea depths on 1x1 minute grid;
- high-resolution array of geographic coordinates of the Black and Mediterranean Seas coastlines.

In addition to that the software can be adopted by a user for various regions and climates.
The advanced quality control software was used within several national and international projects.

Mediterranean and Black Sea Stabilized Temperatures and Salinity gridded Climatology.

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Construction of 3D temperature and salinity fields for model initialization, climatological analysis or graphical purposes is generally performed by a stacking of 2D layers of interpolated/analysed temperature and salinity fields. Indeed, vertical resolution of CTD and XBT profiles generally does not require vertical interpolation, and if so, it can be performed efficiently at the profile level. Hence the horizontal analysis is generally decoupled from the vertical one. However this can lead to some problems, particularly in regions void of data, where the horizontal analysis of two layers, performed independently, can lead to density fields that are statically unstable. Such instabilities, when used in model initialisation, can lead to strong and artificial adjustments in the primitive equation models and should be avoided. Direct applications of variational inverse methods such as that implemented in Diva (Data Interpolating Variational Analysis) or optimal interpolation for gridding in situ data do not guarantee that the interpolated temperature and salinity fields are in hydrostatic equilibrium. A new algorithm for the removal of hydrostatic instabilities from hydrographic data sets was implemented in Diva. The stabilization algorithm software takes the errors of the analysis fields into account.
The principle of the method is to determine values and locations of new pseudo-data that will be added to the original data set in order to assure stability in the analysed field. Optimal pseudo-data location and values are determined using the Data Interpolating Variational Analysis tool Diva in an iterative way. At each iteration, for a given layer, instability locations are determined on the basis of the density field and the correlation length parameter. The value of the pseudo data is computed iteratively by determining the optimal increment to analysed values of temperature and salinity that yields to a non negative Brunt-Vaisala frequency, and it is added to the data set corresponding to the depth for which the error of analysis is the highest.

The stabilisation routine is now a part of Diva software and can be used to produce stable analysis temperature and salinity fields.
Stable monthly gridded temperature and salinity climatology is produced
using Diva software, based on teperature and salinity data sets extracted from the World Ocean Database (WOD09).

We present and discuss two versions of a new gridded temperature and salinity monthly climatologies of the Mediterranean and Black Sea basins, computed in two ways:

1) direct stabilization of extracted monthly climatology data sets.
2) computation of gridded analyses using stabilized seasonal semi-normed reference fields.

The two versions underline the improvements brought by the method.

Session 2 - Data circulation and Services in Ocean science

Oral presentations

SeaDataNet : Project objectives, achievements and future plans

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and the SeaDataNet consortium

Since a large part of the earth population lives near the oceans or carries on activities directly or indirectly linked to the seas (fishery and aquaculture, exploitation of sea bottom resources, international shipping, tourism), knowledge of oceans is of primary importance for security and economy. However, observation and monitoring of the oceans remains difficult and expensive even if real improvements have been achieved using research vessels and submersibles, satellites and automatic observatories like buoys, floats and seafloor observatories transmitting directly to the shore using global transmission systems. More than 600 governmental or private organizations are active in observation of seas bordering Europe, but European oceanographic data are fragmented, not always validated and not always easily accessible. That highlights the need of international collaboration to tend toward a comprehensive view of ocean mechanisms, resources and changes.

SeaDataNet is an Integrated research Infrastructure Initiative (I3) in European Union Framework Program 6 (2006 – 2011) to provide the data management system adapted both to the fragmented observation systems and to the users need for an integrated access to data, meta-data, products and services. Its major objectives are to:

- encourage long-term archiving at national level to secure ocean data taking into account that all the observations made in the variable oceanic environment can never be remade if they are lost;
- promote best practices for data management, taking benefits of the development of international initiatives and standards on data quality insurance, data descriptions (metadata and common vocabulary) and interoperability. Software tools are developed or adapted accordingly to support these practices and the adoption of standards;
- federate different heterogeneous information systems with multiple data formats and multiple applications;
- establish online services to facilitate data discovery, data requests, data visualisation and data download for the users;
- process data sets of reference like ocean climatologies at a regional basin scale to provide comprehensive data sets.

Sustainability of the provided services is researched by a balance between the activities mostly undertaken at National level by the National Oceanographic data centres or some thematic data centres and the effort done at the Pan-European level by the project. The SeaDataNet consortium brings now together a unique group of 49 partners from major oceanographic institutes of 35 countries. Taking in account that valuable work on ocean data management must be done at basin level, most of countries bordering Black Sea, Mediterranean Sea, North-East Atlantic, North Sea, Baltic Sea and Artic Sea are part of the project.

Capacity building of consortium members is necessary to meet project objectives and a comprehensive training program is conducted both for data management and for IT technologies which are necessary to establish such a distributed system: databases management, XML language, web portal and services, GIS technologies.

2010 is the fourth year of the project over five years, and most objectives have been achieved: common vocabularies, standards and procedures, compatible with the Inspire Directive, have been developed and are now widely used both inside the project and outside, common data policy has been adopted, online services have been made available for the entire marine community including direct access to distributed data repositories. Several national or European marine projects rely on these provided services. Strong coordination has been developed with other European marine research infrastructures or Networks of Excellence such as EuroFleet (Research fleet in Europe), ESONET (Sea Floor Observatories), Jerico (Coastal Observatories), EuroArgo (European component of the ARGO International programme). A Memorandum of Understanding has been signed with MyOcean Project (Marine Core Services for Operational Oceanography – GMES). SeaDataNet is also a major technical support for most of the preparatory actions of the European Marine Observation and Data Network (DG-Mare). Other collaborations are foreseen in the short term with other European, North American and International programmes.

Three axis of progress will be explored in the future of SeaDataNet:

- extension of SeaDataNet principles to other types of marine observations such as geophysics and geology by developing strong relationships with other marine communities. The new project Geoseas, coordinated by NERC-BGS, is a good example of such collaborations;
- improving the proposed services and the availability and robustness of these services by making use of recent standards on earth observations (OGC – Sensor Web Enablement, THREDDS) and on quality of services ("Service Level Agreement – ISO 20000/ITIL);
- adaptation of SeaDataNet procedures to the different scale of studies, from local areas to the open oceans. Cooperation with regional organisations will have to be improved in order to produce very accurate products at regional (basin) level.

SeaDataNet Partners:
IFREMER (France), MARIS (Netherlands), HCMR/HNODC (Greece), ULg (Belgium), OGS (Italy),NERC/BODC (UK), BSH/DOD (Germany), SMHI (Sweden), IEO (Spain), RIHMI/WDC (Russia), IOC (International), ENEA (Italy), INGV (Italy), METU (Turkey), CLS (France), AWI (Germany), IMR (Norway), NERI (Denmark), ICES (International), EC-DG JRC (International), MI (Ireland), IHPT (Portugal), RIKZ (Netherlands), RBINS/MUMM (Belgium), VLIZ (Belgium), MRI (Iceland), FMI (Finland), IMGW (Poland), MSI (Estonia), IAE/UL (Latvia), CMR (Lithuania), SIO/RAS (Russia), MHI/DMIST (Ukraine), IO/BAS (Bulgaria), NIMRD (Romania), TSU (Georgia), INRH (Morocco), IOF (Croatia), PUT (Albania), NIB (Slovenia), UoM (Malta), OC/UCY (Cyprus), IOLR (Israel), NCSR/NCMS (Lebanon), CNR-ISAC (Italy), ENSSMAL (Algeria), INSTM (Tunisia)

The Rolling Deck to Repository Project: Transforming the United States Academic Fleet Into an Integrated Global Observing System

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Research vessels coordinated by the University-National Oceanographic Laboratory System (UNOLS) and funded primarily through the National Science Foundation are the primary platforms supporting oceanographic research in the U.S. and include “global” to “local” class ships capable of operating throughout the deep oceans and within coastal and inland waterways. Each vessel is equipped with a suite of sensors, including geophysical, water column, and meteorological sensors, that are available for continuous operation during each expedition. The “underway” datasets obtained from these sensors provide characterization of basic environmental conditions for the oceans and are of high value for later reuse for building global syntheses, climatologies, and historical time series of ocean properties.

With their global capability and diverse array of sensors, the research fleet vessels operate as essential mobile observing platforms for ocean science. With the high costs and increasingly limited resources for ocean exploration, data collected on every expedition are of high value for science. However, at present, there is no coordinated data management infrastructure for the U.S. research fleet. Data collection and documentation practices vary widely, and the integration of ocean observations across vessels is difficult. The dissemination and archiving of oceanographic data sets is severely limited with existing long-term National Data Center archives, including the National Geophysical Data Center (NGDC) and National Oceanographic Data Center (NODC), holding select products from some expeditions and typically available only years after a survey is conducted. A routine and comprehensive inventory of underway shipboard sensor data for the academic research fleet in the U.S does not exist.

The recently funded Rolling Deck to Repository (R2R) Project aims to develop a comprehensive plan for fleet-wide data management to ensure preservation and accessibility of oceanographic research data resources. The R2R Portal (www.rvdata.us) is being developed as a central shore-side data gateway through which underway data from oceanographic expeditions will be routinely cataloged and securely transmitted to the national long-term digital data archives including the National Geophysical Data Center (NGDC) and the National Oceanographic Data Center (NODC). R2R will provide essential data documentation services for every expedition along with new tools to improve documentation of the wide array of shipboard data collection activities typical of modern expeditions. Protocols will be developed for quality assessment of high priority underway data types, to provide feedback to operators on data quality and integrity. The R2R project plan is to leverage and augment the existing centralized information resources of the UNOLS office, ship operators, and US National Data Centers to facilitate the documentation and delivery of oceanographic data from “rolling deck” to “repository.”

This presentation will provide an overview of the goals and design of the R2R Data System. Companion presentations will provide details on data quality assessment (Miller et al.), cruise data breakouts (Clark, Arko et al.), management of MET data (Smith, Arko et al) and linkage with disciplinary data centers (Chandler et al.). R2R is a collaborative effort, involving the Lamont Doherty Earth Observatory, the Scripps Institution of Oceanography, the Woods Hole Oceanographic Institution and the Florida State University. R2R is funded as a five-year program from the US National Science Foundation (NSF) Oceanographic Instrumentation and Technical Services Program.

Oceanographic Database System at NIO, Goa, India: Recent Improvements

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The Indian Oceanographic Data Centre at NIO, widely known as IODC, was created in 1964 along with the institute (NIO) as the National Oceanographic Data Centre (NODC) under the IOC/IODE data centre network. IODC was recognized by the Department of Ocean Development, (presently, named as the Ministry of Earth Sciences) as one of the 14 National Marine Data Centres (NMDCs) in India in 1994. IOC/IODE recognized IODC as Responsible National Oceanographic Data Centre for the Indian Ocean (RNODC-INDO) in 1996.

Ever since the establishment of IODC, the Centre was actively involved in the delayed mode data management for oceanographic parameters (the mandate set for the centre by the institute), covering the Indian Ocean and the marginal seas (Arabian sea, Laccadive Sea, Bay of Bengal and the Andaman Sea) with an emphasis to acquire, reprocess, reformat, quality control and store all data sets in a database or in any convenient system for easy and efficient retrieval & supply to end users. Data delivery to end users has been supplemented by the production of user-friendly software interfaces to publish data sets electronically on Hard disk or CD-Rom or Web. In addition, IODC carries out work in developing techniques for processing, display and dissemination of oceanographic data. As part of its contribution to the international network, IODC participates in different elements of the International Oceanographic Data Exchange (IODE) system.

Hydrography station data

An important feature of IODC data management is the integrated data and information system comprising of a common meta data (information that describes data inventory) which include the name of the data, summary, attributes, geographic location, data currency, quality, custodian, how to access, purpose for which data are collected and finally whom to contact. The system provides geographical, seasonal and parameter wise catalogue information and can retrieve the data requested using multi-level parameter selection criteria. The system integrates metadata information along with oceanographic profiles of any parameter from the database.

A relational database management system, Oracle version 9i is in use at IODC. The hydrographic data files include meta data as well as digital data on temperature, salinity, dissolved oxygen, phosphate, silicate, nitrate & nitrite, ammonia, alkalinity, primary productivity, chlorophyll a and zooplankton bio-mass in the water column and zoo-benthos, microorganisms, geo-chemical parameters etc. in various tables, while the master table being the inventory or meta data. The tables are indexed with a primary key and a secondary key usually known as IODC cruise number and station number. The database supports querying with multiple search selection criteria for data visualization and generation of various data products. A programming interface enabling access provides a fast, reliable and efficient way of accessing the data/information through a structured query language (SQL) with backend development tools (Developer-2000, pro-C, etc.) while third generation programming languages (C, FORTRAN) are used for the database development.

Geophysical track data

For accessing the geophysical parameters like marine bathymetry, gravity, magnetics etc. a separate data management procedure is adopted following the UGDEF-2008 format for the storage and

retrieval of data. Data formatting is done using C++, Matlab and Awk programming. Cruise data is separated into different track lines and plotted in GMT (Generic Mapping Tools) to obtain high quality postscript maps in various projections including their customization. Features like zooming of maps are also introduced. Data for about 50 cruises are converted in this format.

Web based data services

In recent years, a web based application service is introduced using the state of the art technologies for the benefit of users. Now, data/information can be accessed on both the intranet (for NIO users) and internet (at the institute's website http://www.nio.org). The data base is split into two frames, namely, i.e. original cruise reports (meta data) and cruise data (digital). Search can be made to access ship cruise information by selecting vessel name, cruise number, geographic area, calendar year and discipline category such as physical, chemical, biological and geological. Further, each field is divided into parameter type viz., temperature & salinity (Hydro-cast, CTD, MBT, XBT, DBT), dissolved oxygen, phosphate, silicate, nitrate, nitrite, pH, alkalinity, primary productivity, chlorophyll a, zooplankton, phytoplankton, benthos etc. Further searches are also possible to select the required data in a grid form including field/parameter for a specific time period and to download the data. Mapping routines are also used to plot the station location map of each field/parameter selected. Thus, information/data for about 950 ship cruises over the period from 1973 to 2006 is available to the user community. From this point of view, IODC joins the international scientific community in exchanging and sharing data/information which is a pre-mandate under IOC/IODE/RNODC network.

Live Access Server (LAS)

Recently, a new features - Live Access Server (LAS) and OPeNDAP/ THREDDS Data Server (TDS) are introduced to view and access the data for end user application. LAS is a highly configurable web server designed to provide flexible access to geo-referenced scientific data. It provides visualization, comparison and substituting of multi-dimensional scientific data for web users. It can be used for local data as well as data from remote servers. Data sets uploaded to the server, include the Levitus climatology (WOA2005), COADS climatology, Hellerman and Rosenstein, weekly chlorophyll a climatology data set (1998-2005), improved 2-minute bathymetry data of the Indian Ocean, etc. The THREDDS Data Server (TDS) is a web server that provides metadata and data access for scientific datasets, using OPeNDAP, OGC WMS and WCS, HTTP, and other remote data access protocols. The application of Ocean Data View (ODV) is also used to provide the salient results from various ship cruise data, particularly of chemical and biological data sets displayed as quick look information.

IODC activities envisaged in the coming years include expansion and management capabilities of various databases covering time-series data sets from the moored RCMs and ADCPs, Estuarine and coastal ocean database, ARGO profile database etc. In addition, appropriate preparations also started to meet the data management needs to handle the increased inflow of ship data with the acquisition of two new research vessels by the institute.

Data services for Pacific Island communities: developing the Pacific Integrated Ocean Observing System

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The US contribution to the Global Ocean Observing System (GOOS) is the Integrated Ocean Observing System (IOOS). IOOS is organized around regional associations (RA), and PacIOOS is the RA for the US-affiliated Pacific Islands. An initial pilot project for PacIOOS involves intensive observations, regional modeling and associated data services for the Hawaiian Islands (HiOOS). A major component of both PacIOOS and HiOOS is the establishment of data services to provide direct access to the collected data. For the majority of PacIOOS, this involves web-services for static geospatial data such as coastlines, underwater features, ecosystem assessments, etc. For HiOOS, on the other hand, this involves providing access to near-real-time data streams from in-situ sensors that measure, for example, water quality, ocean currents and waves. The presentation will focus on the variety of data services, challenges and future plans of HiOOS and PacIOOS.

1. HiOOS data management

The HiOOS data management effort focuses on providing direct access to all the ocean measurements being collected, as well as access to numerical model output. The core service is based on the Thematic Real-time Environmental Distributed Data Services (THREDDS) developed at Unidata. The THREDDS DODS Server (TDS) provides binary access to model output, as well as to data from remote gliders, near-shore sensors, water quality buoys, and satellites. Eventually the TDS will also serve high-frequency radar (HFR) output, pending installation of all the sites. In addition to TDS, HiOOS is running different web-based tools for browsing data. These are based on the integration of Google API's and open-source utilities. Finally, HiOOS has initiated a sensor observation service (SOS) based on OCG standards for providing station data in real-time to general users.

2. PacIOOS data management

In comparison to the HiOOS effort, the focus in the broader Pacific is more on geospatial data served via web map services. While HiOOS has a wide array of real-time, in-situ measuring assets, the rest of the Pacific does not. Instead, the PacIOOS effort will focus on the aggregation of existing data sets, reformatting and geo-referencing if necessary, and then serving out via a map server. The focus to date is on data collection and the development of the web services.

The two sites can be found at http://hioos.org and http://pacioos.org.

Archive and Access of Global Water-Level Data: from the Coast to the Deep-ocean

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The National Geophysical Data Center (NGDC) is one of three environmental data centers within the U.S. National Oceanic and Atmospheric Administration (NOAA) Satellite and Information Services. NGDC also hosts the World Data Center (WDC) for Geophysics and Marine Geology which provides long-term archive, data management, and access to national and global tsunami data for research and mitigation of tsunami hazards. Archive responsibilities include the global historic tsunami event and run-up database, the bottom pressure recorder data collected by the Deep-ocean Assessment and Reporting of Tsunami (DART®) stations, coastal tide-gauge data, historic marigram data, as well as other related hazards and bathymetric data and information. NGDC and the WDC are working to provide long-term stewardship and sustainable standards-based Web discovery and access to these data.

The full network of NOAA DART® stations was completed in 2008. NGDC archives and distributes the high-resolution 15 second deep-ocean pressure and temperature data for each DART ® deployment. As of 2008, NGDC also archives and stewards the high-resolution (1-minute or finer) coastal water level data collected by NOAA's National Ocean Service and Tsunami Warning Centers. In addition to the high-resolution digital data, NGDC is rescuing historic marigram records. To date, over 3,000 analog tide gauge records have been scanned to high-resolution TIF images. We are in the process of integrating these images with the on-line historic tsunami database and are exploring possible mechanisms to digitize these images in 2011. These efforts at data archive addressed a portion of a research requirement for long-term stewardship of and easy access to global water level data.

NGDC is collaborating with various international organizations to address the remaining requirements. NGDC and the WDC are committed to distributing water level data supporting research and hazard mitigation in standard formats available through the Open Geospatial Consortium Web Map and Web Feature Services (WMS and WFS). We are working with our international and national partners to develop sustainable methods for long-term archive and access to these important data.

The JCOMM Expert Team on Marine Climatology: A Report from the Third Session

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The Third Session of the Expert Team on Marine Climatology (ETMC) is taking place in Melbourne, Australia, 8-12 February 2010. This Team, which operates within the Data Management Programme Area (DMPA) of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), has within its mandate to collaborate with a variety of international programs to determine procedures and principles for the development and management of climatological datasets—these may range from global down to regional scales, and span both oceanographic and marine meteorological data. The agenda for this upcoming session includes a review of contributions and requirements of the world climate programme and other climate related programmes; the operational flow, archaeology, and archival of data and metadata falling under the JCOMM umbrella; data quality and exchange issues; marine-meteorological and oceanographic climatological summaries; and planning for future marine data and climatology workshops. This paper will summarize results from the session of particular interest to the IMDIS community—highlighting issues related to the management of contemporary ocean data and metadata, and their products such as climatologies—including anticipated future directions in these areas.

World Ocean Database 2009

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The “World Ocean Database” (WOD) is the largest collection of ocean profile data available internationally without restriction. WOD is produced by the NOAA National Oceanographic Data Center and its’ co-located World Data Center for Oceanography. The database contains data for temperature, salinity, oxygen, nutrients, tracers, among other variables. The WOD can be considered to be a collection of CDRs that are all in one common format, with systematic quality-control applied and with all available metadata and documentation made available both online as well as DVD to make WOD useful to users. The amount of data in the WOD has grown substantially since WOD was started in 1994 for two reasons. One is the increase of data available from in situ remote-sensing systems such as moored buoys, from ship-of-opportunity programs collecting XBT data, from the Argo profiling float project, and other observing system projects. The second reason is due to the success of the Global Oceanographic Data Archaeology and Rescue (GODAR) project sponsored by the Intergovernmental Oceanographic Commission. For example this project “located” and “rescued” approximately 3 million temperature profiles for the pre-1991 period which have been added to WOD. The data in WOD have been used to make estimate of the interannual to interdecadal variability of temperature, salinity, and oxygen for the past 50 years. This talk will describe WOD and results from the GODAR project.

NAIAD : a new advanced system to access satellite data

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A great effort has been undertaken by numerous projects and frameworks in order to provide an homogeneous access to satellite data, relying on common standards and technologies for metadata, data content, format (NetCDF) and access (ftp, OpenDAP). This effort, while making much easier the life of users and the development of applications using and merging these data streams, is still to be strengthened when considering the optimization of the data flow : full resolution swath data are still very voluminous, bandwidth consuming and complicate to manage, due to their sampling pattern, especially when focusing on very regional areas. It is of high interest for applications and users to download only the relevant data for their need, filtering out for instance invalid or contaminated images, or out-of-boundary swath sections.

The Naiad system is a highly powerful and open framework for the dissemination of voluminous multi-parameter swath data, initially developed by Ifremer, and supported by ESA and EUMETSAT, and now as a partnership with JPL/PODAAC, used in the frame of several projects (GHRSST, Ocean & Sea-Ice SAF, CERSAT, PODAAC). As a data selection and subsetting tool, it provides unique features such as multi-criteria data search, cross-sensor colocation, subsetting, regridding, visualization and automatic generation and dissemination of customized products directly to users and it is based on existing standards (OpenDAP). It greatly facilitates the implementation of advanced data mining applications. It is also meant to provide advanced thematic indexing of data (storms, fronts, extreme events,..) relating observations from different sources into a single comprehensive database, based on the outputs of advanced feature identification and tracking, image processing or mining workflows.

A web interface for gridding and visualizing oceanographic data sets

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Spatial interpolation of observations on a regular grid is a common task in many oceanographic disciplines (and geosciences in general). Diva (Data-Interpolating Variational Analysis) is an analysis tool for gridding oceanographic in situ data. Diva takes the error in the observations and the typical spatial scale of the underlying field into account. Barriers due to the coastline and the topography in general are also used to propagate the information of a given observation spatially. Diva is a command-line driven application. To make Diva easier to use, a web interface has been developed. The user can directly upload his/her data in ASCII format and enter several parameters for the analysis. The analyzed field, location of the observations, and the error mask are then directly visualized in the browser.

While this interface allows the user to create his/her own gridded field, a web interface is also developed to visualize pre-computed gridded oceanographic data sets. Those data sets are typically four-dimensional (longitude, latitude, depth and time). The system allows to visualize horizontal sections at a given depth and time to study the horizontal distribution of a given variable. It is also possible to display the results on an arbitrary vertical section. To study the evolution of the variable in time, the horizontal and vertical sections can also be animated. The user can customize the plot by changing the color-map, the range of the color-bar, the type of the plot (linearly interpolated color, simple contours, filled contours) and download the current view as a simple image or as Keyhole Markup Language (KML) file for visualization in applications such as Google Earth.

The system is build using a client and server architecture. The server is written in Python using the Web Server Gateway Interface. The server implements version 1.1.1 and 1.3.0 of the Web Map Service (WMS) protocol of the Open Geospatial Consortium. On the server, all oceanographic data sets are stored as NetCDF files organized in folders and sub-folders allowing for a hierarchical presentation of the available variables. The client is build as a web application using the OpenLayers Javascript library. The web interface is accessible at http://gher-diva.phys.ulg.ac.be/. It is currently used for climatologies created in the frame of the SeaDataNet project and will be used for the EMODNET project (chemical lot). Thrid-party data centers can also integrate the web interface of Diva to show an interpolated field of in situ data as an additional WMS layer.

The Genes Mapserver: A web based information system on microbial genes and genomes in the ocean

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Marine ecosystems are covering more than 70% of the earth's surface, host the majority of biomass and significantly contribute to global organic matter and energy cycling. Microorganisms are known to be the "gatekeepers" of these processes. Sequencing the complete microbial genomic content of marine samples is more and more becoming routine based on astonishing advancements in DNA sequencing technologies. Massive sequencing of microbial organisms allows gaining insights into the genomic basis of their catalytic activities, life style and fitness.
Nevertheless, it is increasingly apparent that the full potential of comparative genomic analysis can only be achieved if the geographic and environmental context of the sequence data is considered (Field, et al., 2008, Hughes Martiny and Field, 2005).

The Genes Mapserver is the first web resource which offers integrated access to genomic and environmental datasets. It provides digital maps of prokaryotic genomes, metagenomes, viruses and diversity datasets based on ribosomal DNA sequences. The Genes Mapserver allows to overlay the genomic data with a rich set of environmental data such as temperature, nitrate, phosphate, etc., based on profile and remote sensing data from e.g. the World Ocean Database. All maps are highly interactive and can be flexibly combined to explore the environmental context. For each individual point details about the sampling site including raw environmental data and indicators of environmental stability can be browsed. Additionally the Genes Mapserver allows post factum retrieval of interpolated environmental parameters for any point in the open ocean.
The Genes Mapserver is completely based on open source software. Moreover, this web based mapserver is developed making a point of implementing and using existing standards. Among others the Web Map Service (WMS) standard of the Open Geospatial Consortium (OGC) was implemented allowing programmatic access via web services.

The Genes Mapserver is the first resource of its kind to offer access to this unique combination of environmental and molecular genomic data, with manually curated habitat descriptors (Lynette, et al., 2008) for all genomes, metagenomes, and marker genes, their respective contextual data, and additionally integrated environmental data. Especially the integration of oceanographic data in the context of molecular biology and the simple user interface of the Genes Mapserver is a unique service to bridge the gap between oceanography and microbiology.

The Genes Mapserver is part of megx.net (http://www.megx.net) a web portal for Marine Ecological GenomiX (Kottmann, et al.) and available under http://www.megx.net/gms.

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Quadrige2: Operational information system for French coastal monitoring

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Ifremer has developed the Quadrige database since the mid 90's. Quadrige has been designed to manage data generated by environmental coastal monitoring programmes. This information system is based on a Relational Database Management System and proposes a set of services for long term archiving of raw data, data selection and access, data validation, data processing and interpretation.

Quadrige records time series over about 40 years at more than thousands fixed locations around the French coast including overseas territories for:

- hydrology,
- chemistry and contaminants in the water column and in the sediments,
- phytoplankton and associated toxins,
- biology and microbiology.

Quadrige is part of the French water information system (SIE) and contributes to the French normalisation group on water data (SANDRE). Quadrige is the reference database for the coastal environmental data collected by Ifremer and his partners. It must support international commitments such as the European Water Framework Directive, OSPAR and regulations on the sanitary controls for shellfish production areas, in particular in terms of environmental reporting. Quadrige is also the national database for coastal and estuarine waters by the French Ministry of Ecology and Sustainable Development.

Two years ago, a new version of the database (Quadrige²) was designed and is now under routine operation taking into account new technologies and new needs. Quadrige² provides several new functionalities for:

- integration of new monitoring programmes, such as the benthic survey (REBENT),
- spatial representation, a crucial need for both scientific purposes and coastal environment spatial planning. Quadrige² is able to manage spatial data (both vector and raster data), and to make them available via geographical information system (GIS) standardized interfaces such as OGC standards,
- online exchanges of data between international, European and national organisations,
- compulsory diffusion of environmental information to the public.

A special attention has been paid for general public information as recommended by the European regulations (Water Framework Directive, INSPIRE and Aarhus convention). All validated observations, all products such as environmental indicators for classification of water bodies are freely accessible via the Quadrige² portal and can be linked to other observations such as terrestrial observations within the French water information system.
In the same idea, the French system for biodiversity management (SINP) will use extensively Quadrige² data through interoperable web services.

In addition, Quadrige² has also been designed to be able to manage spatial observations and indicators on French continental margins, such as habitats, as committed by the European Marine Strategy Directive (DG-Mare) which will enter in force progressively. In this context, Quadrige² is now connected to preparatory actions of the European Marine Observation and Data Network both for chemical, biological and habitat aspects.

Data Centre for French Coastal Operational Oceanography: Metadata and data access

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The data centre for French Coastal Operational Oceanography (cdoco-exploit@ifremer.fr) has been created 4 years ago in the frame of PREVIMER (http://www.previmer.org), the pre-operational system aiming to provide a wide range of users, from private individuals to professionals, with short-term forecasts about the marine coastal environment along the French coastlines bordering the English Channel, the Bay of Biscay, and the Mediterranean Sea.

The data centre collects a wide range of data types that the user models (like PREVIMER) integrate to deliver forecasts:
• forcing data: wind, pressure, humidity, cloud coverage and ocean-atmosphere fluxes from the French national meteorological service (METEO-FRANCE) and from ACRI, river discharges providing by the French central hydro-meteorological service (SCHAPI), temperature and salinity climatologies, results from large scale oceanographic models from MERCATOR OCEAN and INGV,
• reference data: bathymetry, coast lines,
• in situ measurements, for model validation or assimilation: temperature, salinity, dissolved oxygen and turbidity data from several networks (MAREL - coastal multi-parameters automated stations -, RECOPESCA - sensors installed on volunteer fishing vessels -), sea-level data from the tide gauge RONIM network of the French hydrological service (SHOM), wave height and direction from the swell buoys network of the national centre of maritime and fluvial technical studies (CETMEF), currents from drifting buoys.
The results of PREVIMER and partners models are also archived in the data centre.

In the first stage of its development the data centre has focused on:
• the development of the software to collect and archive all the data and to distribute it to the models,
• the development of the infrastructure to safeguard data collected for the models and model results (hindcast, nowcast analyses and forecast),
• the monitoring of the data centre in order to provide an operational service.

In the second stage, once the system is operational, the data centre gives priority to metadata and data access. More automated accesses are currently developed to meet the growing demands of data, particularly from other operational systems. In this context, the following methods will be established:
• metadata, described following ISO-19115 requirements, is available through a Web catalogue of products. Information about ocean parameters, geographical coverage and time range, spatial and temporal resolution and data access procedures are available. This catalogue is coherent with MyOcean product catalogue (same data model, same vocabulary - EDMO Seadatanet Directory, BODC Parameter Discovery Vocabulary, CF metadata standard names -),
• the organization of the archives and the files formats is homogenized by data type:

-the Netcdf files of the different models results are stored in "rolling archive" (typically 3 months) and "best estimate" archives,
-the Csv files of the in-situ data are distributed in a single common space.

• model results are available through Opendap: the “best estimate” series of many models results can be accessed by Opendap clients,

• in situ data can be accessed through PREVIMER Web site:
-public data is freely available without restrictions (rivers flow-meters, meteorological buoys, MAREL buoys),
-restricted data can be visualized by all users and downloaded only by authorized users after authentication (tide gauges, swell buoys, devices measuring rainfalls).

Some in situ data delivered by PREVIMER partner’s (METEO-FRANCE, CETMEF, SHOM, SCHAPI), received in real time, are outside the scope of the data centre for French Coastal Operational Oceanography. The providers remain the reference data centres for these data types. The goal is not to duplicate databases from outside agencies but to provide real-time data compilations necessary for actors of the coastal operational oceanography.

The Fisheries Observatory of Ifremer - Monitoring network of fisheries resources, practices and economics

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Developed in strong collaboration with the French Ministry of Agriculture and Fisheries, the Fisheries Observatory of Ifremer (FOI) contributes to fulfil one of Ifremer public interest missions consisting of identification, evaluation, understanding, forecasting and promotion of sustainable exploitation of marine resources. It aims to build an operational and multidisciplinary monitoring network, allowing a comprehensive view of fishery systems including their biological, technical, environmental and economical components.

The objectives of the FIS are (i) to provide the specifications and methodologies for the collection, storage and processing of fisheries data, with the constant concern to harmonise all these procedures on a national scale, (ii) to improve data management system and access to data for a wide-spread public, and (iii) to produce and distribute relevant datasets, indicators and synthesis, for understanding and evaluation, including bio-economic diagnostics of the fisheries, and assessment of the short and long-term impacts of fisheries management scenario and measures.

To reach these objectives, the FOI has been structured in 5 interacted sub-programs, collecting data by different processes:

- Fisheries statistics (landings, through log books) and surveys on activity of the fleet
- Economics data, collected by survey
- Biological sampling of landings
- Observation of the catches aboard fishing vessels (landings and discards)
- Scientific survey data (aboard the oceanographic research vessels)

To further an integrated analysis of the fishery systems, the wide range kinds of data - including acoustic surveys of water columns, biological in-situ observations, environmental observations, as well as fishing efforts and landings - are managed in a single data management system, based on a relational data base, named Harmonie, with geographical facilities to allow direct interface with Geographical Information Systems (GIS) and data access and visualisation services on the web. This system is compliant with the regulations of the European Data Collection Framework (DCF – DG-Mare) for reference data such as species, fishing gear or fleets.

Products and synthesis are periodically processed such as the “Annual Synthesis of French Fisheries” to present status and trends of the fishing activity and resources.

Alg@base: a tool for research, management and visualization of the Baltic Sea monitoring data

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Increased eutrophication with heavy annual blue green algae blooms formed in the 1980's a great threat for the Baltic Sea. It was essential to increase the public awareness and to demonstrate the temporal and spatial extent of the problem to the environmental decision makers.

As a response to this challenge, marine scientists developed a near real-time, low cost observation system to observe, evaluate and disseminate current information of nuisance blooms.

Innovative, high-tech phytoplankton monitoring system was installed in 1993 on a commercial ferry Finnjet with the support of Silja Line. It was the first ferrybox phytoplankton monitoring system for the Baltic Sea which consequently formed the Alg@line co-operation. Ever since then the near real time phytoplankton monitoring data as chlorophyll, species composition, nutrients, temperature and salinity has been collected.

Alg@line has expanded into a co-operation of several research institutes and environmental centers in Finland and into international co-operation between Finland, Estonia, Sweden and Germany. Ferrybox monitoring systems are currently installed on 6 ferries cruising in the Baltic Sea.

Two kind of data is observed: a flow-through system records salinity, temperature and chlorophyll fluorescence every 20 seconds with the spatial resolution of about 250 m, and a sequence water sampler takes one liter water samples every 50 nautical miles for laboratory analysis of phytoplankton species composition and nutrient contents. Flow through data is transferred from the ferry every hour via satellite connection. After automatic preliminary quality control the data is loaded into the Alg@base MySQL-database.

Current and long term Alg@line data and information about phytoplankton blooms is available on web (http://www.algaline.fi). For online users the system has a web application to visualize and analyse the current data and data over long time. Users can extract the in situ data eg. for the validation of satellite image analysis and hydrodynamic and ecosystem modeling.

Alg@line data is routinely used in the Finnish Ice Service and provided to Baltic Operational Oceanographic System's ftp-service (BOOS-ftp). Data is extensively used in HELCOM MONAS work. Data is provided for EU research service program MyOcean and ESA project MARCOAST. Also in connection with of SeaPRISM instrument in Aerosol Robotic Network - Ocean Colour (AERONET-OC) Alg@line in situ data has been used for bio-optical modeling in development and validation of satellite algorithms for Case-2 coastal waters.

The awareness of the deteriorating environmental state of the Baltic Sea has increased since 1990's. Operative Alg@line is the system that offers to decision makers and public an user-friendly and near real-time way to information about the current state and trends of the Baltic Sea.

Development of a Marine Biological Data Portal within the framework of the European Marine Observation and Data Network (EMODNet)

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Based on an extensive one-year consultation phase, the European Commission published a Maritime Policy Blue Book in 2007. One of the key-actions is the creation of a sustainable European Marine Observation and Data Network (EMODNet) in order to assemble fragmented and inaccessible marine data into interoperable, contiguous and publicly available data streams for European maritime basins. Since May 2009, four pilot portals for respectively hydrographic data, marine geological data, chemical data and biological data are under development. This initial development phase will last three years and during this phase, the biological pilot will focus on spatial distributions of phytoplankton, zooplankton, angiosperms, macro-algae, invertebrate bottom fauna, reptiles, bird communities and sea mammals in the Greater North Sea, the Bay of Biscay and the Iberian Coast. The portal will be built on top of the existing European Ocean Biogeographic Information System (EurOBIS), which allows the user to search multiple datasets containing biogeographic information on marine organisms simultaneously. Through the use of standards for geographic data (OGC), metadata (INSPIRE) and vocabularies (SeaDataNet), the different EMODNet Portals will be able to communicate and exchange information through the web. The biological pilot action is now in the process of identifying long-term, pan-European biological data holdings to serve the EMODNet objectives. Based on the collected data and information, a set of derived or processed biological data and products to serve private bodies, public authorities and researchers will be made accessible online. Most of these derived 'dataproducts' will be discussed and created through a series of workshops with both experts and the different user communities.

Biobank: An integrated system to collect and publish marine mammals informations : in situ observations, necropsy results, tissue samples available for further scientific research.

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Since 1990, marine mammals stranded on the Belgian coast and by-caught animals are systematically necropsied. During these post–mortem examinations various tissues samples are collected and preserved. They form the Belgian Marine Mammals Biobank (BMMB). Since 1995, through collaboration with France and the Netherlands, the geographical coverage of the collection extends to the entire continental coastline of the Southern North Sea. The tissues are collected, fixed following standard protocols and stored at the Royal Belgian Institute of Natural History and at the University of Liege (Belgium). Samples from the following species are currently stored in the BMMB: small cetaceans (harbor porpoise, white beaked dolphin, white side dolphin, bottlenose dolphin and striped dolphin), large cetaceans (sperm whale, humpback whale, minke whale, fin whale and Sowerby's beaked whale) and pinnipeds (harbor seal, gray seal and hooded seal). Samples are preserved by different methods (formalin-fixed tissue, formalin-fixed paraffine embedded tissue, frozen tissues (-20°C) and ethanol fixed tissues). For each sample of stranded or by-caught animal, the following documentation is available: species, age, sex, date and place of the stranding, morphometric data, conservation code, and results of post-mortem investigations.

In 2009, more than 23.000 samples were available in the BMMB but no specific system existed yet for management of the associated information.

As one of the goals of the BMMB is to make samples of marine mammals available for research at the national and international levels, a specific database accessible through a web portal was designed and developed to facilitate data and tissues exchange. The aim of this presentation is to show how the BMMB database and website were built, in order to identify, locate and use marine mammal data and samples. These samples are available for research purpose only and specific access rules have been designed in order to promote non-profit scientific collaboration.

For the database design, the data flow has been identified in its broadest sense by also taking into account the information on living animals. Any characteristic or measurement on a given animal can be recorded during different linked events like: observation at a given place, transfer of ill animal for revalidation purposes, release of recovered animal and necropsy. The results are directly entered in the Oracle database via the web interface by the responsible scientists. A group management system and an authentication system have been developed to secure the web application. The web interface presents a flexible tool for incrementally searching the recorded information.

The resulting integrated information system replaces several, more or less independent, databases, datasets and paper archives. It also allows various views of the stored information, like public access to records of strandings or sightings of marine mammals, or a more detailed view on animals and linked samples by registered users for scientific use. The setup enables an easy incorporation of observations or tissue samples at any location. The system, developed and managed at the Belgian Marine Data Centre, is available at www.marinemammals.be.

Geo-Seas - a pan-European infrastructure for the management of marine geological and geophysical data.

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The Geo–Seas project will create a network of twenty six European marine geoscience data centres from seventeen coastal countries including six from the Baltic Sea area. This will be achieved through the development of a pan-European infrastructure for the exchange of marine geoscientific data. Researchers will be able to locate and access harmonised and federated marine geological and geophysical datasets and data products held by the data centres through the Geo–Seas data portal, using a common data catalogue. The new infrastructure, an expansion of the exisiting SeaDataNet, will create an infrastructure covering oceanographic and marine geoscientific data. New data products and services will be developed following consultations with users on their current and future research requirements. Common data standards will be implemented across all of the data centres and other geological and geophysical organisations will be encouraged to adopt the protocols, standards and tools which are developed as part of the Geo-Seas project.

Availability of integrated primary marine data is an essential element of marine research, economic activities and environmental management. This will be facilitated through the development of a pan-European infrastructure which includes standardisation of data management within the repositories and middleware which will allow users to identify, locate and share oceanographic and marine data.

Oceanographic and marine data include a wide range of variables an important category of which are the geological and geophysical data sets. This data includes raw observational and analytical data as well as derived data products from seabed sediment samples, boreholes, geophysical surveys (seismic, gravity etc) and sidescan sonar surveys. All of which are required in order to produce a complete interpretation of seabed geology.

Despite there being a large volume of geological and geophysical data available for the marine environment it is currently very difficult to use these datasets in an integrated way between organisations due to different nomenclatures, formats, scales and coordinate systems being used within different organisations and also within different countries. This makes the direct use of primary data in an integrated way very difficult and also hampers use of the data sets in an integrated way to produce multidisciplinary data products and services.

The overall objective of Geo-Seas project is to build and deploy a unified marine geoscientific data infrastructure within Europe which will in effect provide a data grid for the sharing of this data. This will result in a major improvement in the locating, accessing and delivery of federated marine geological and geophysical data and data products form national geological surveys and research institutes across Europe. There is an emphasis on interoperability both with other disciplines as well as with other key framework projects including the European Marine Observation and Data Network (EMODNet) and One Geology – Europe.

A key objective of the Geo-Seas project is to underpin European directives such as INSPIRE as well as recent framework programmes on both the global and European scale, for example GEOSS and GMES, all of which are intended to encourage the exchange of data and information.

Geo-Seas will adopt the pre-existing SeaDataNet methodologies including architecture and middleware components, where appropriate, to interconnect the geological and geophysical data centres. This will facilitate the integration of the geological and geophysical datasets with other oceanographic data which is managed by the SeaDataNet data centres. This will not only avoid unnecessary duplication of effort within the project where there are pre-existing technologies but it will also facilitate multidisciplinary use of oceanographic and marine data.

Geo-Seas will undertake to develop the data products and services required by the end users. These products and services will be identified by the analysis of the responses to a user questionnaire which will be disseminated throughout the user community. The results of which will guide the development of services and products which will be delivered by the project to the end user.

In addition Geo-Seas will develop and maintain a common index of the data, products and services which are available. This will also include harmonisation of data standards and exchange formats to facilitate access and delivery of data to the end user communities.

To ensure interoperability with other marine environmental data Geo-Seas ISO19115 metadata, OGC and GeoSciML standards will be used as the basis for the metadata profiles for the geological and geophysical data. This will be largely achieved by modifying the SeaDataNet metadata standard profile (Common Data Index or CDI), which is itself based upon the ISO19115 standard, to accommodate the requirements of the Geo-Seas project

Metadata for the Geo-Seas data portal will be produced by the local data centres and will then be harvested automatically by the centralised Geo-Seas metadata base system. This methodology will allow the metadata bases to be kept up to date with regular updates being done effectively and efficiently.

Prior to Geo-Seas, EuroCore, EU-Marsin and EuroSeismic, also EU funded projects, lead to the development of the EU-SEASED metadata service which provides an inventory of seabed material and seismic surveys. This inventory forms a good basis for the Geo-Seas metadata inventories and also for the development of the Geo-Seas metadata formats. However, EU-SEASED only provides metadata and Geo-Seas will build upon this giving the end user transparent and controlled access to the data and data products which are ready and available for use. This will be achieved via the internet using middleware and ISO compliant metadata.

In addition Geo-Seas will also build on the work which has been done by the SEISCAN and SEISCANEX projects. This will include integration of the SEISCANEX metadata into the Geo-Seas metadata bases with the SEISCANEX data centres being adopted as nodes within the Geo-Seas infrastructure thus making this data more widely available to the user community. The SEISCANEX metadata will also be upgraded to the Geo-Seas ISO19115 based format and will allow users to download images of the seismic data as well as selected images for conversion to SEG-Y which can then be reprocessed.

The SEISCANEX archive will be also be improved with digital navigation files being created for the seismic data. Currently there is navigation information available for the seismic but this is not always in an ASCII format.

Geo-Seas comprises eleven work packages and many of the activities in these work packages, especially those starting early in the project, are focussed on the development of the Geo-seas infrastructure and the provision of harmonised geological and geophysical datasets to the end user.

In addition there are also activities focussed on formats and vocabularies which include identifying the potential synergies with the GeoSciML project, the objective of which is to develop an international standard for geoscience data interoperability, as well as One-Geology-Europe and EMODNet.

Those activities where the work packages have a later start date are aimed at developing services for the distribution and viewing of derived products, for example, maps, lithological logs, high resolution viewing services for seismic reflection data.

Geo-Seas data products will be largely maps and it is envisaged that the there will be an exchange and integration of these map products with those of other EU funded projects particularly One-Geology – Europe, which is developing a digital geological map of Europe, and EMODNet which will be serving out seabed maps for several European sea regions using the One Geology – Europe portal services. This will in turn enhance the potential for interoperability between these and other projects and also facilitate a multidisciplinary approach to ocean science within Europe.

Geo-Seas consortium partners:
NERC-BGS (United Kingdom), NERC-BODC (United Kingdom), NERC-NOCS (United Kingdom), MARIS (Netherlands), IFREMER (France), BRGM (France), TNO (Netherlands), BSH (Germany), IGME (Spain), INETI (Portugal), IGME (Greece), GSI (Ireland), BGR (Germany), OGS (Italy), GEUS (Denmark), NGU (Norway), PGI (Poland), EGK (Estonia), LIGG (Lithuania), IO-BAS (Bulgaria), NOA (Greece), CIRIA (United Kingdom), MUMM (Belgium), UB (Spain), UCC (Ireland), EU-Consult (Netherlands), CNRS (France), SHOM (France), CEFAS (United Kingdom), and LU (Latvia).

The project is coordinated by British Geological Survey (BGS), while the technical coordination is performed by Marine Information Service (MARIS).
The Geo-Seas project is an Integrated Infrastructure Initiative (I3) of the Research Infrastructures programme within EU FP7, contract number RI-238952. It has a duration of 42 months from 1st May 2009 till 31st October 2012.

Establishing clusters of data providers to ensure sustainable access to quality data in ocean science: The case of the MAREMIP initiative

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Interactions between oceans and climate are strongly influenced by the biogeochemical activity of plankton on various time scales. Carbon sequestration to the deep-sea by the plankton “biological pump” and interactions between plankton calcifiers, carbonate chemistry and ocean acidification are two well-know examples. Moreover, it is now well recognised that distinct functions are carried out by distinct plankton groups.

Global ocean ecosystem models open up new and exciting avenues of research to explore these interactions, but their parameterisation and validation require plankton data with a global coverage and a wide range of plankton functional groups. The key to ensure a sustainable flow of quality data in ocean science is to engage the scientific community.

As part of the marine ecosystem model intercomparison project (MAREMIP), and following the recommendations of the EUR-OCEANS meeting of experts on Plankton Functional Types data (Le Quéré and Pesant (2008) EOS Trans. AGU 90: 30-31), PANGAEA® is establishing clusters of plankton data providers from laboratories and institutions in Europe and around the globe. The clusters will cover :

(1) pigment analysis of plankton protists;

(2) analysis of prokaryotic and unicellular eukaryotic plankton by flow cytometry;

(3) manual microscopic analysis of plankton protists;

(4) manual microscopic analysis of plankton metazoa;

(5) semi-automated imaging & analysis of plankton & particulate matter; and

(6) advanced imaging microscopy of plankton.

The objectives of each cluster are :

(1) to establish a network of data providers in Europe and globally;

(2) to establish the flow of historical and new data available from the cluster to selected permanent archives;

(3) to establish a policy for open access to data within the cluster and open/restricted access outside the cluster;

(4) to define cluster-specific common vocabularies in collaboration with metadata initiatives to facilitate the aggregation of data;

(5) to perform quality control on data; and (6) to provide ancillary data as available.

Data curators at PANGAEA® (and other archives specified by the clusters) will perform quality control and assurance on the completeness, consistency and standardization of metadata, including geo-references, currencies, units and common vocabulary describing parameters, taxonomy, size and functional groups, collection methods and analytical methods. Authoritative registers for taxonomy (e.g. WoRMS and ITIS) and chemical substance (e.g. CAS) will be used.

Freeing oceanographic and polar data through The Polar Information Commons

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The Polar Regions (the Arctic Ocean and adjacent seas, the Southern Ocean and the Antarctic continent) are changing rapidly with dramatic global effect. Wise management of resources, improved decision support, and effective international cooperation on resource and geopolitical issues require deeper understanding and better prediction of these changes. Unfortunately, polar data and information remain scattered, scarce, and sporadic.

Inspired by the Antarctic Treaty of 1959 that established the Antarctic (including the Southern Ocean south of 60° South) as a global commons to be used only for peaceful purposes and scientific research, we assert that data and information about the polar regions are themselves “public goods” that should be shared ethically and with minimal constraint. We therefore envision the Polar Information Commons (PIC) as an open, virtual repository for vital scientific data and information that would provide a shared, community-based cyber-infrastructure fostering innovation, improving scientific efficiency, and encouraging participation in polar research, education, planning, and management. The PIC will build on the legacy of the International Polar Year (IPY), providing a long-term framework for access to and preservation of both existing and future data and information about the Polar Regions.

Rapid change demands rapid data access. The PIC system will enable scientists to quickly expose their data to the world and share them through open protocols on the Internet. A PIC digital label will alert users and data centers to new polar data and ensure that usage rights are clear. The PIC will utilize the Science Commons Protocol for Implementing Open Access Data, which promotes open data access through the public domain coupled with community norms of practice to ensure use of data in a fair and equitable manner. A set of PIC norms is currently being developed in consultation with key polar data organizations and other stakeholders. We welcome inputs from the broad science community as we further develop and refine the PIC approach and move ahead with implementation.

Posters

MyOcean In-Situ Thematic Assembly Centre : a new In-situ service for operational oceanography

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MyOcean INS-TAC partners

MyOcean is the implementation project of the GMES Marine Core Service, aiming at deploying the first concerted and integrated pan-European capacity for Ocean Monitoring and Forecasting. Within this project, the in-situ Thematic Assembly Centre (in-situ TAC) of MyOcean is a distributed service integrating data from different sources for operational oceanography needs. The MyOcean in-situ TAC is collecting and carrying out quality control in a homogeneous manner on data from outside MyOcean data providers to fit the needs of internal and external users. It provides access to integrated datasets of core parameters for initialization, forcing, assimilation and validation of ocean numerical models which are used for forecasting, analyses (nowcast) and re-analysis (hindcast) of ocean conditions. Since the primary objective of MyOcean is to forecast ocean state, the initial focus is on observations from automatic observatories at sea (e.g. floats, buoys, gliders, ferrybox, drifters, SOOP) which are transmitted in real-time to the shore. The second objective is to set up a system for re-analysis purposes that requires products integrated over the past 25 to 50 years

The purpose of the proposed talk is to present the services that will be provided by Thematic Assembly center at global, European and regional scales, the way it is organized and how it collaborates with existing infrastructures (JCOMM observing System and their Global Data Centers , IODE/NODC and in particular SeaDataNet) and the products that will be provided. It will also show how it relies on standards and how interoperability principles have been used to set up such a distributing service for operational oceanography needs

CASPINFO and Black Sea Scene projects and meta-data on environment

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Institute of Environmental Geoscience of the Russian Academy of Sciences (IEG RAS) carries out fundamental and applied research in environmental geosience, engineering geology, hydrogeology, and seismology; and coordinates these studies within the scope of federal, academic, and municipal programs.
The main research problems solved in the institute are as follows:

- Development of theory and methods of predicting and monitoring natural and human-induced disasters.
- Fundamental problems of ground-water development and dynamics; resources, utilization and protection of ground water.
- Development of the theory of soil and rock properties formation and transformation under the effect of natural and anthropogenic factors.
- Development of fundamentals of geodynamic, seismic, and engineering-geological zonation.
- Development of geoenvironmental principles of disposal and remote monitoring of large industrial objects and waste repositories.
- Geoenvironmental problems on the territory of megacities.
- Development of geoinformation technologies and the methods of processing cartographic information for solving geoenvironmental problems.

IEG RAS is engaged in performing the following priority research in the Earth Sciences:

"Environmental Geology"
"Resources, Dynamics, and Protection of Ground Water"
"Geodynamics, Stress State of the Bowels, and Disastrous Processes"
"Geoinformatics"
"Environment Research and Monitoring"

IEG RAS participates in carrying out the programs and projects "Development of Federal System of Seismic Monitoring", "Volga River Revival", "Complex Development of Russia Territory Adjacent to the Caspian Sea", "Safety", "Global Change", "Radionuclide Contamination of Soils and Rocks at the site of Radioactive Waste Disposal at Mayak Industrial Association and within the Areas Subjected to the Chernobyl Accident: Field Data Analysis and Modeling", "Study of mass exchange processes in multiple porosity media with application to saline water and brine transport in aquifers", "Assessment and Prevention of Geoenvironmental Hazards from Natural and Anthropogenic Disasters Influencing the Sustainable Development of Environmental-Economic Systems", "Geological and geophysical stability in Urbanized Areas", "Landslide hazard Assessment and Mitigation for Cultural Heritage Sites and Other Locations of High Society Value" , ''Effects of MHD-Generated Electromagnetic Discharges on the Seismic Regime'', Sochi Olimpic Games 2014, South Stream gas pipeline monitoring , Blue Stream.
IEG RAS is the principal executor of the Blue Stream project aimed at the engineering-geological monitoring of the Russia-Turkey pipeline on the Black Sea bed.

Many of these researches are connected with environmental problems of Caspian Sea and Black Sea. There are many environmental and political problems around this region: the Caspian Sea status, its delimitation, possibilities of using of resources by the coastal states, estimation of power resources and their joint usage, geopolitical situation in the region, its military and strategic potential and the problem of security, the development of the oil and gas resources and its influence on the social and economic development of the neighboring states.
Environmental data analyses combined for CASPINFO and BSS could help in some of these problems decision

HiSeasNet: Providing Internet services to the US Academic Oceanographic Fleet

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Access to the Internet is an integral part of nearly every research lab, classroom, and office on land at least in the developed world. Extending this access to the University-National Oceanographic Laboratory System (UNOLS) fleet –the US academic seagoing laboratories—is the purpose of HiSeasNet http://www.hiseasnet.net), a not-for-profit Internet service provider operated by Scripps Institution of Oceanography and funded primarily by the US National Science Foundation. For the ships, HiSeasNet provides:

- Basic communications-email, web browsing, voice and video teleconferencing for scientists, engineers and crew at sea;
- Transmission of hot data in near-real-time to shore-side collaborators;
- Tools for real-time educational interactions between shipboard scientists, teachers and the classroom, as well as informal science and other education and outreach activities.

Starting with a single ship in 2001, HiSeasNet now includes 16 ships and teleport facilities at the San Diego Supercomputer Center. The network includes both global C-band and regional Ku-band coverage. The larger global ships using C-band circuits are equipped with 3-axis stabilized 2.4m antenna systems while Ku-band coverage is provided with from 1.0m to 1.5m systems. The Teleport uses 7.0 m C-band and 3.8m Ku-band antenna systems to provide global and regional network coverage.

HiSeasNet services include installation, commissioning and licensing of shipboard Earth stations, on-going maintenance of both ship and shore equipment, satellite bandwidth management, and teleport routing onto the Internet. The current network is a star topology with each ship connected to the Teleport. Each ship has at least an un-contended 96 kbps ship to shore circuit and shares a 512 kbps shore to ship circuit with at most four other ships, using single channel per carrier circuits,. Virtual private networks are established between the ships and their operating institutions to facilitate management of the individual ships' traffic and control of their own IP services (email, web browsing, VoIP, video teleconferencing, etc.) and access policies. In addition to operations and maintenance, HiSeasNet continuously explores new technologies for increasing bandwidth and services while minimizing costs. We shall review several of these changes.

HiSeasNet is currently self-supporting with the on-going costs of operations and maintenance charged as a supplement to the Ships' normal technical services day-rate. Average traffic is about 20 GBytes/ship/month. With the current day-rates, this works out to approximately $0.10/MB for Ku-band and $0.20/MB for C-band traffic with the larger global ships operational about 70% of the time and the smaller regional ships operational about 45% of the time. For reference, the cost of transmitting a MB via Iridium is approximately $100 to $150 and via Fleet Broadband $5 to $9.

Establishment of Clearing House System for Marine Information in Japan

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In the Basic Plan on Ocean Policy formulated in July 2007 in Japan, it has been requested to establish a system to comprehensively manage and provide the data and information now scattered in respective agencies, so as to provide them for private companies and research institutions in a user-friendly manner and enhance effectiveness of marine surveys by respective agencies, with a view to contributing to the development of marine industries and the improvement of scientific knowledge.

It has also been requested that, in the process, efforts made so far by agencies such as the Japan Oceanographic Data Center (JODC), which has carried out international services under the framework of International Oceanographic Data and Information Exchange (IODE) promoted by Intergovernmental Oceanographic Commission (IOC) of UNESCO, should be utilized at a maximum to make the system effective and efficient, while seeking cooperation from universities, local governments and private companies as well. It should be ensured that collected and managed information is accumulated comprehensively over a long period of time.

A task team consisted of the following ministries and agencies concerned in Japan was organized to discuss measures for the development of the system to comprehensively manage and provide the data and information scattered in the respective agencies.

Co-secretariat: Headquarters for Ocean Policy, Japan Coast Guard
Members: Ministry of Education, Culture, Sports, Science and Technology (MEXT), Ministry of Defense (MOD), Ministry of the Environment (MOE), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Agency for Natural Resources and Energy (ANRE/METI), Japan Fisheries Agency(JFA), Japan Meteorological Agency (JMA), Geographical Survey Institute (GSI), JAMSTEC

The task team decided to develop a Clearing House System for Marine Information in JHOD. The clearing house system will manage and provide metadata of marine data and information managed by each agency. The metadata of the system contains attribute information of the marine data or information, such as title, summary, contact, time scale, special scale and etc, so that users could easily find necessary data or information through the system, and could get it if it has been opened on the Internet by the respective agency.

A format of the metadata was developed based on Japan Metadata Profile (JMP) 2.0 which was formulated by Geographic Survey Institute in Japan in compliance with ISO 19115 metadata standard. The task team decided to cover a variety of categories for the marine data or information managed in the system, such as ocean physics, ocean chemistry, marine environment, marine biology/ecosystem, marine meteorology, topography/geophysics/geology, energy/mineral resources, geographic boundaries, spatial utilization/conservation information, disaster prevention information etc. The system coveres not only scientific data but also social information, such as marine research cruises and facility information, publications and the legislations concerned. User friendly interface and functions have been considered in the system providing synonyms dictionaries, pill-down menu or retrieval function on map etc.

It is scheduled to become in operation on the Clearing House System in March 2010.

In-situ delayed mode dataset at the Coriolis Data Center

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Coriolis is a french programme basically aimed to contribute to the ocean in situ measurements part of the French operational system. It has been especially involved in gathering all global ocean in-situ observation data in real time, and developing continuous, automatic, and permanent observation networks.

A new comprehensive and qualified ocean in-situ dataset, the COriolis Re-Analysis (CORA), is produced for the period 1990 to 2008. This in-situ dataset of temperature and salinity profiles, from different data types (Argo, gts data, vos ships, nodc historical data...) on the global scale, is meant to be used for general oceanographic research purposes, for ocean model validation, and also for initialisation or assimilation of ocean models.

To produce this dataset, several tests have been developed to improve the quality of the raw database and to fit the level required by the physical ocean re-analysis activities. These tests include some simple systematic tests, a test against climatology and a more elaborate statistical test involving an objective analysis method. Visual quality control (QC) is performed on all the suspicious T and S profiles. The statistical test is based on a objective analysis run with a three weeks window to capture the most doubtful profiles which are visually checked by an operator to decide whether or not they are bad data or real oceanic phenomena. Then a second run which takes into account only the good data, is operated on a weekly window to produce the gridded fields. Each release provides T and S weekly gridded fields and individual profiles both on their original levels and interpolated levels. These Coriolis products are available on different servers using different technologies (ftp, OPeNDAP and web).

Development of Korea Ocean Biogeographic Information System

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Korea Ocean Biogeographic Information System (KOBIS) has been developed to collect occurrence information on marine organisms in Korean waters and provide to scientists and the public using GIS interface. Occurrence information was mostly retrieved from research articles, project reports, and illustrated books of marine organisms and some information was directly submitted by the managers of on-going research projects.

Ecological and DNA barcode information on marine organisms was also included in the data archive if such data exist. From 122 reference books, a total of 45,624 occurrence records of 1,134 marine organisms were collected. Through the quality control process, the data whose positions were located wrong in land were excluded.

The Oracle DB system installed on Windows 2003 Server was adopted for management of the collected data. After analysis of data characteristics, 11 DB tables were designed for data management and GIS data provision. The data were prepared for DB input according to the DB structure and stored in DB by Oracle data loader. KOBIS web site was established to share the biogeographic information with marine biologist world wide. Several web programs using Google map API were developed to search data from DB system and to show the location of data on the map. KOBIS plays a role as the Korea node of international OBIS (iOBIS).

Global Temperature and Salinity Profile Programme

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The Global Temperature and Salinity Profile Programme (GTSPP) is a joint program of the International Oceanographic Data and Information Exchange committee (IODE) and the Joint Commission on Oceanography and Marine Meteorology (JCOMM) of the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC). Tasks in the GTSPP are shared amongst the participating countries including but not limited to Argentina, Australia, Canada, China, France, Germany, India, Italy, Japan, UK, and USA.
Scientists and data managers in these countries contribute their time and resources to ensure the continued functioning of the program.

The GTSPP has four primary objectives:

(1) to continue to provide a timely and complete data and information base of ocean temperature and salinity profile data of known and documented quality in support of global and local research programs, national and international operational oceanography,

(2) to continue to implement data flow monitoring and reporting systems for improving the capture and timeliness of the GTSPP real-time and delayed mode data to prevent data losses,

(3) to continue to improve and implement agreed and uniform quality control and duplicates management systems by coordinating activities among all participating countries and

(4) to facilitate the development and provision of a wide variety of useful data analyses, data and information products, and data sets.

The success of the GTSPP allows users access to the most up-to-date, highest quality and resolution data at the time of request by managing both real-time and delayed mode data. It delivers data to users through complete quality control (QC) and duplicates elimination procedures within 48 hours of data collection (occasionally possible delay up to 30 days due to data transmission difficulties) and has standardized quality control procedures for ocean temperature and salinity profiles that have been adopted in many other projects and countries.

The two most important activities that the GTSPP is undertaking are:

1. Management of expendable bathythermographs (XBTs) data: The GTSPP has preserved original XBT data in the GTSPP Continuously Managed Database (CMD). This is critical for the examination and correction of the recently identified XBT depth bias problem, since the oceanographic community does not have consensus on what causes this bias or how to correct it;

2. Implementation of unique data tag identification: GTSPP has developed and implemented the algorithm of Cyclical Redundancy Check (CRC) as a way to uniquely tag data circulating on the Global Telecommunication System (GTS) and the original profiles used to create the real-time messages.

The paper describes a framework for developing and implementing operationally a state-of-the-art data and information portal with capabilities of exploring in-situ data from near real-time data streams and integrating the data streams with historical data. The paper also provides recommendations in order to ensure the interoperability of data and information systems, which are being developed in different countries.

Establishing best practice for the digitization, documentation and dissemination of historical marine biological data at IBSS

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Marine biological data are expensive to collect and to collate and time consuming for process. Biological sample processing requires human expert and hand processing (often via microscope); metadata is rather complex and very important; electronic data profile preparation takes days to weeks or even months.

The data formats used and metadata fields applied are dependant on the type of marine biological data – phytoplankton, zooplankton, fishes, benthos, etc. and makes the implementation of data management procedures even more difficult.

Many marine biological researchers have always considered and still are considering data management as technical, boring and an unnecessary thing and as a result data management is often insufficiently planned or not planned at all, and is assigned a low priority.

Due to the specifics of marine biological data management very large amounts of extremely valuable marine biological data and metadata stored at former Soviet Union (and some other) scientific institutions are still at risk being lost due to:

- Media degradation (such as floppy disks that can degrade)
- Catastrophes (fires, floods …)
- Neglect
- Retirement or death of researchers
- Equipment failure.

The Laboratory of Marine Information Systems (LaMIS) at Institute of Biology of the Southern Seas (IBSS), National Academy of Sciences of Ukraine, has started the process of digitization, archiving, documentation and dissimilation of historical marine biological data 2 years ago. The Laboratory is working not only with raw data on paper sheets but also with data already digitized within several national and international projects which now don't satisfy the modern requirements. In many cases the time required to check, attach metadata, properly document and archive already digitized data is incomparable to time required to digitize it from scratch and needs more efforts. This paper also will present the common errors, mistakes and gaps from the previous digitization projects.

The common guidelines for digitization process of marine biological datasheets are being developed and implemented. The main guideline that is being applied to all datasheet is to archive raw data without any corrections, deletion etc. The scan or photo of paper sheets with raw data is being mandatory attached to the digitized raw data in a database.

Also the guidelines for very important thing - species names digitization are being developed and applied to all digitized datasets.

To ensure the data interoperability, the controlled vocabularies (SeaDataNet Vocabularies) are applied to metadata where it is possible and appropriate. For all types of marine biological data the standards

for dataset documentation are being developed taking into account the international marine data management best practices and experience.

The digitized, documented and quality checked biological datasets are disseminated to the IBSS scientists and entire scientific community through the institutional website and are automatically being provided to OBIS (Ocean Biogeographic Information System) via DiGIR (Distributed Generic Information Retrieval) software. Some types of biological data can be presented in ODV (Ocean Data View) format (such as the total phytoplankton sampled at discrete depths). This gives a possibility for data contribution to the CDI databases.

For the moment thousands of phytoplankton and zooplankton records were digitized(work on invertebrates just started) documented and archived in MS SQL 2008 database. About 200000 biogeographical records for the Black and Mediterranean Seas were contributed to OBIS (EurOBIS). The process of digitization is put at the institute on the regular bases. LaMIS works on ensuring that the process of digitizing, documentation and archiving is done on the modern basis, taking into account requirements of international data interoperability and data exchange approaches.

Multidisciplinary marine cast data management system for SESAME EU project

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Significant number of oceanographic observations is being carried out on episodic oceanographic stations (or oceanographic casts). Each cast provides vertical profiles of physical, chemical and biological parameters. Efforts by the international oceanographic community brought to the accumulation of most historical cast data in large scale databases which support online data selection (for example WOD09, SEADATANET). Aiming for worldwide data storage, these databases are not optimized to suite the requirements of regional and relatively short time investigations.
Intensive four years large scale project SESAME is aimed to assess and predict long term changes in the Mediterranean and Black Sea ecosystems. A SESAME-CAST system was developed to support rescue of historical and acquisition of new multidisciplinary data as well as processing and analysis of the data. The system includes four software packages:

- Mobile Mediterranean Microsoft ACCESS database (MEDACC).
- Advanced data Quality Control block for MEDACC database.
- Advanced oceanographic interface for MEDACC database.
- Online interface for SESAME-CAST database.

MEDACC is a portable MS ACCESS database developed in IOLR for storage, exploration, visualization and processing of multidisciplinary marine data acquired in oceanographic cruises by casting of measurement equipment and/or water samplers on sea stations. The system supports data import in MEDATLAS and Sea-Bird ASCII formats as well as EXCEL tables in a form similar to generic ODV spreadsheet format (Schlitzer, R., 2001: Ocean-Data-View). Selected data can be exported to ASCII files in MEDATLAS format or in the generic ODV spreadsheet format. Data imported into MEDACC could be explored using the common ACCESS query builder as well as an oceanographic oriented interface for most typical data visualisation. To plot data the MEDACC uses the widely distributed commercial software “SURFER” (Golden Software Inc), and Microsoft “Excel”. The “MEDACC setup utility” as well as “User Manuel” and “update utility” can be downloaded from ISRAMAR server. The setup utility creates an empty MEDACC type database. One can also download a MEDACC type database containing Mediterranean and Black Sea public available data. The MEDACC type database with the entire SESAME cast data collection has limited dissemination according to SESAME data policy.

Advanced data Quality Control block for MEDACC type database is developed by MHI team. The QC block implements mostly SEADATANET accepted procedures, including SEDATANET convention for QC flags values. The procedures require the use of a climatic array for parameters. Current version uses MEDAR/MEDATLAS II based climatology where only limited number of physical and chemical parameters are presented. Once activated, the QC block checks all user selected data and estimates the QC flags corresponding to the controlled metadata and data. The QC block can work in either automatic or manual mode. The manual mode allows users to visualize observations, validate assigned QC flags and make interactive corrections to metadata, data and QC flags. The software can be downloaded as a zip file from the SESAME-CAST web page.

Advanced oceanographic interface for MEDACC type database (Hydrolog-MEDACC) is a development of MHI. Hydrolog-MEDACC is a version of the Hydrolog software package for oceanographic analysis and processing of multiparametric cruise data which are stored in a MEDACC

type data base. Hydrolog-MEDACC provides graphical user interface for data selection and production of various plots or maps and transects which are generated using “SURFER” (Golden Software Inc). The Hydrolog-MEDACC software can be downloaded as zip file from the SESAME-CAST web page.

Online interface for SESAME-CAST database allows access to the metadata of the most recent collections of marine cast data within SESAME project. The collection is constantly updated by ISRAMAR team in a MEDACC type database named SESAME-CAST-Mobile. All datasets submitted through the SESAME data management web site in MEDATALAS or ODV Excel formats are controlled and imported periodically into SESAME-CAST-Mobile database. After each update, the MS SQL Server database is synchronized with the updated mobile database. The MS SQL Server database is used as the base of the online interface to the SESAME cast data collection. Using the interface any visitor can perform metadata queries in the SESAME-CAST DB and download data in ODV generic format. However, the user’s ability to download data is limited by the degree of data accessibility, which is defined according to SESAME data policy.

The European Sea Level Service delayed-mode tide gauge data portal

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Currently, many European countries provide information about their tide gauge networks and access to their sea level data through their own national web sites. However, users face the problem of how to efficiently access the data from many countries in a uniform manner. This has long been recognised as an issue by the European Sea Level Service (ESEAS) and Europe continues to need a single system for a variety of reasons (e.g. without it neither IPCC and other study groups nor national decision makers are being provided with the fullest information on changes in extreme sea levels, etc.)

The British Oceanographic Data Centre (BODC) has developed the delayed-mode tide gauge data portal for ESEAS. Eventually, this will provide standardised access to most of the sea level data and information available in Europe, maintained by national sea level authorities.

The data portal has been set up following principles established under the EU ESEAS Research Infrastructure project (ESEAS-RI). BODC retrieves data that originators have placed on their own ftp sites, loads the data and metadata into a database and then makes them accessible to registered users via the data portal website.

A modified version of the data format agreed in the ESEAS-RI project was developed, using controlled vocabularies to populate heading metadata, and validator software was created by BODC to check the integrity of the data files. This validator software is sent out to the data originators to allow them to check their files before supplying them to BODC. The software is employed again within BODC to check data are valid before loading into the database.

BODC have developed automatic retrieval and checking software, which trawls the originators ftp sites and retrieves new or more up-to-date files. The data are loaded into the database, and any duplicate data are replaced by the most recent data.

The website allows users to search the tide gauge data by a number of criteria and will deliver files of any size, based on the date range the user has requested.

MyOcean Marine Core Service

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c/o the MyOcean partner network (http://www.myocean.eu.org)

MyOcean (http://www.myocean.eu.org) is a GMES Marine Core Service whose objective is to provide freely a common denominator data for all users requesting an information on the ocean: the ocean information for downstream services. This common denominator data describes the ocean currents, temperature, salinity, sea level, primary ecosystems, ice coverage for Global Ocean & European Regional Seas monitoring and forecasting. Data are referenced in myOcean catalogue with information on commitments, quality and accuracy. They are delivered thanks to added value functions which are for instance, observation data combination and assimilative models, continuity and consistency, expertise on the ocean, an end to end information system for knowledge sharing and interfaces management, a singler service desk and web portal. The users are marketed into 4 segments: 1 – Marine Safety (marine operations, oil spill combat, ship routing, defense,search & rescue), 2 – Marine Resources (fish, stock management, ICES, FAO), 3 – Marine and Coastal Environment (water quality, pollution, coastal activities), 4 – Climate & Seasonal Forecasting (climate monitoring, ice, seasonal forecasting).. Key users are the EU (mainly EU agencies, the EU Member States and intergovernmental bodies.

MyOcean started on 1st april 2009 as a project granted by the European commission (7th Framework Program), the GMES « Marine Fast Track » project with the objectives to specify, design, develop, implement, run and validate the ocean monitoring and forecasting service for Europe. The project is organised around the concept of a system of systems as pre-initiated by the previous european FP6 projects like Mersea, Boss4GMES, Marcoast and ECOOP. We are entering now the transition to operation phase that will conduct the European “operational oceanography” community towards the operational phase of a GMES European service which demands more European integration, more operationality, and more service. By 2012, the ocean service should be operational, based on a « service oriented » organization to bring up a new pan-european value for ocean monitoring and forecasting for the benefit of the marine service providers on duty at national or European levels. This ocean service should also get aboard the link for continuous innovation and improvements and the feedback for sustainability. To make it happen, MyOcean relays on a Pan-European network composed of 61 partners out of 29 countries and a core group of 20 partners committed for operations; european best monitoring and forecasting systems. The total budget is 55 M€, with 34 M€ EC funding.

The ocean data are produced – and enhanced thanks to dedicated expertise – by two type of centers, either observations or thematic assembly center (TAC) or monitoring or forecast centers (MFC):

- They are Five TACs to provide past and current ocean information derived from satellite observations – Sea Level, Ocean colour, Sea Surface Temperature, Sea Ice & Wind – and in situ observation network.
- They are Seven MFCs to provide ocean analyses and forecast information fitted to the global ocean and European basins, Arctic, Baltic, Atlantic Northwest shelves, Atlantic Iberian / Biscay / Ireland area (Ibiroos), Mediterranean sea, Black sea.

TACs and MFCs (see figure 3) are engaged in the system through Operating Level Agreement (OLA), to regularly and systematically deliver qualified products identified in the products and services portfolio. These engagements will define level of qualification, access and monitoring tools.

Users will discover, browse, register and access the products by means of a central & unique service desk and web portal. The interface for data access is harmonized and standardised, replying to the Inspire directive and the need to manage a federated and interoperable information system. The access means will vary depending on data sets , basic versus advanced download functions (web coverage service and link with archival systems), visualization functions (web map service). The

information system stores all the information about the data needed to run myOcean – the product data base, full inventory including the MyOcean catalogue – and account for user transactions. It provides interfaces to monitor technical interfaces with production units in order to have an updated knowledge of the state of the system of systems, timeliness and availability of products, and transmit quality information.

The talk will end with a presentation on system of systems organisation, link with other external information systems and what is targeted in 2010.

The Cyprus online data management tools for the Mediterranean and the Black Sea

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The Cyprus Oceanography Center the last decade has constantly explored and implemented innovative methods and new developments concerning the use of Information Systems (IS) in Oceanography, to suit both the Center's monitoring and forecasting products. Within the frame of this scope two major online managing and visualizing data systems have been developed and utilized, those of CYCOFOS and BYTHOS. The Cyprus Coastal Ocean Forecasting and Observing System – CYCOFOS provides a variety of operational predictions such as ultra high, high and medium resolution ocean forecasts in the Levantine Basin, offshore and coastal sea state forecasts in the Mediterranean and Black Sea, tide forecasting in the Mediterranean, ocean remote sensing in the Eastern Mediterranean and coastal and offshore monitoring. Online visitors may explore these products using the Center's web site. Moreover, the user has the possibility to view the history of displacement of surface drifters as well oil spill and trajectory predictions of the CYCOFOS MEDSLIK model in the Levantine using Google Maps and Google Earth. A recently new IS of CYCOFOS allows the user to view the data gathered by the Cyprus glider fleet in real time and gain information regarding salinity, sea temperature, oxygen and other marine measurements. The implementation of the ECOOP dynamic quick view service by CYCOFOS provides the ability to seek and view the CYCOFOS forecasts up to two years time back and the user can easily move through subsequent days' hours to view different forecasting fields or create animations. In addition, CYCOFOS provides access to its operational forecasting and observing data, through a user registration progress. The BYTHOS online data system aims to provide a rich internet application which enables users to search, visualize and download marine data obtained by various observing platforms in the Mediterranean and Black Sea. The BYTHOS online data system allows the users to search the database based on the type, name and date of the available cruises and view the results on Yahoo! map interface. The results include the stations comprising the cruise, its route, the stations profiles as well as metadata regarding the cruise. The stations profiles are created dynamically and may include information regarding temperature, oxygen, salinity, nutrients, and others. In addition, the provided information may be downloaded either for individual stations or for the whole cruise in MEDATLAS format. Yahoo! maps used by BYTHOS offers a friendly visualization tool. Two ongoing developments of BYTHOS are to support multiple repositories (non-local) through a single user interface and in addition modify it to suit the needs of the operational oceanographic forecast fields as well.

EMODNET Chemical pilot, being implemented by using the SeaDataNet infrastructure

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EMODNET Partnership: OGS (Italy), MARIS (Netherlands), NERC-BODC (United Kingdom), IFREMER (France), BSH-DOD (Germany), IMR (Norway) NERI-MAR (Denmark), VLIZ (Belgium), RBINS – MUMM (Belgium), NIOZ (Netherlands), SMHI (Sweden), HNODC-HCMR (Greece), RIHMI-WDC (Russia), SIO-RAS (Russia), MHI (Ucraine), IO-BAS (Bulgaria), NIMRD (Romania), TSU-DNA (Georgia), ICES (International), AWI (Germany), ULG (Belgium), IEO (Spain), CLS (France), MI (Ireland), OC-UCY (Cyprus)

EMODNET is a preparatory action for a final operational European Marine Observation and Data Network. EMODNET aims to assemble fragmented and inaccessible marine data into interoperable, continuous and publicly available data streams for complete maritime basins. The EMODNET Chemical pilot is focused on the groups of chemicals required for monitoring the Marine Strategy Directive: synthetic compounds (pesticides, antifoulants, pharmaceuticals), heavy metals, radionuclides; fertilisers and other nitrogen- and phosphorus-rich substances, organic matter, hydrocarbons including oil pollution. It concerns the Greater North Sea, including the Kattegat and the English Channel, the Black Sea and five spots in the Mediterranean (Balearic Sea, Gulf of Lion, North Adriatic Sea, Gulf of Athens and NE Levantine basin). In view of a later expansion to all European Seas and to explore the methods for achieving an overall consistent quality of data sets and products, the consortium has decided to expand the first two pilot regions.

EMODNET Chemical lot is based on SeaDataNet network of NODC's, which oversee data collection for the requested geographic areas, will run and further develop SeaDataNet infrastructure, which provides a unified and transparent overview of metadata and a controlled access to large data collection, in combination with other multidisciplinary data sets. Specific expertise will coordinate data analyses and validation, and the creation of data products.

This approach and synergy will have mutual benefits for the EMODNET chemical pilot and for SeaDataNet: it guarantees an easy expansion of the geographical coverage of the EMODNET chemical data sets to other seas, because SeaDataNet Data Centres are located and established in all countries riparian to the European seas; it guarantees an easy expansion and merging with other types of marine data sets, because SeaDataNet already handles a large volume of multi-disciplinary data sets and other initiatives are planned and underway for enlarging the SeaDataNet coverage by connecting to other networks, such as the biological community via EurOBIS and MarBEF and the geological & geophysical community via upgrading and integrating of EU-SEASED and SEISCAN; it facilitates a long term sustainability of the infrastructure, because the infrastructure and network are based upon the NODC's, which are usually part of large marine research institutes and which receive long term funding from their institutes for managing and safeguarding marine data sets. The infrastructure and consortium are not just created for the EMODNET tender and might fall apart, once the EU funding halts. SeaDataNet is in a position to continue its services, especially when there is a perspective for a wider implementation of EMODNET; it challenges SeaDataNet to prove its concept, network and infrastructure, which implicates that the EMODNET pilot will be developed by a dedicated and motivated team; it guarantees that high quality and long expertise with handling marine data will be mobilised for handling and processing the EMODNET chemical data sets; it makes optimal use of existing infrastructure and ongoing SeaDataNet developments, - the time lines are in parallel, which provides excellent opportunities for synergy, whereby the EMODNET tender will give an extra stimulus to the development of the V2 data products viewing and presentation services; it will provide excellent efficiency and cost effectiveness by combining efforts and developments, not only technically, but also organisation-wise. There is no need to create any specific new database for these data, because the SeaDataNet decentralised scheme of databases is in place for managing the chemical data sets, and the discovery and access services will be implemented by using the SeaDataNet Common Data Index

(CDI) system (based upon ISO 19115). The network of national partners and their national networks will be mobilised to collect, process, manage and give access to the collated data sets and products. The existing SeaDataNet expertise in data processing, statistical analyses and quality control as well as in generating aggregated data products will be used and further developed as part of the EMODNET pilot.

A set of 16 parameters were selected considering the analyses carried out by the EEA and EMMA working groups as well as the availability of data over the three geographic areas and over time. The SDN Common Vocabularies have been extended to be able to handle all the requested data.
www.emodnet-chemistry.eu

A regional oceanographic database for the Nordic Seas: from observations to climatic dataset

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Observational datasets and climatologies are essential tools for the monitoring of the ocean climate change and models simulation/validation. Besides the fact that in situ observations at the sea are difficult, expensive and scarce the existing generalized datasets are still not complete and derived climatologies suffer from serious disadvantages. The sources of deficiency can be divided into three main categories – incomplete initial dataset, inadequate quality control and limitations resulting from objective interpolation. Therefore improvement of datasets for climate research should include efforts in all directions simultaneously.

Region under study located northward of 60o parallel and includes Iceland, Norwegian, Greenland and Barents Seas commonly known as the Nordic Seas (NS). This is one of the most sampled regions of the World Ocean of primary importance for shaping of the global climate due to strong air-sea interaction and intermediate and deep water formation. Current version of the database contains observations at more than 450,000 oceanographic stations (bottle, CTD, profiling floats) for 60o-82oN, 45oW-70oE geographic area since 1870 up to 2009.

Original database for the NS was compiled in the Arctic and Antarctic Institute (AARI), nearly 2.5 million stations were added form more than 30 sources. Station metadata and profiles are being permanently updated by comparison with original cruise reports, data reports and manuscripts under GODAR project.

Special software was developed for the data storage and processing. Its functionality generally follows to the main stages in the data processing and includes three main applications. First application (ODB3ALoad) is designed to produce merged quality-duplicate controlled observed level database and interpolated level database with assigned quality control flags. Merging procedure was designed to create an ‘operational’ observed level dataset with reduced instrumental and vertical biases. The duplicates identification algorithms allow automatic detection and metadata/profiles merging to generate complete oceanographic station composition from multiple duplicates. The application contains convertors from original formats to common database format. The second (ODB3A) represents a graphical user interface for data access, visualization and analysis including advanced data selection, data editing, import, export, modules for spatial and temporal statistics. Application supports data catalog and interactive selection from a map. Embedded module allows preparing ASCII files for objective analysis. The last application (ODB3AClimate) provides access to objectively analyzed fields and related services. It allows computing of mean climatological fields, anomalies fields and different climatologies comparison. On the whole, the applications provide complete technology for oceanographic data processing and analysis. Flexible modular structure of the applications allows quick modification and extension.

Applied quality control (QC) on observed data had several stages. It started from checking of the variables physical range. Observed depth levels were controlled by four procedures. The vertical resolution for CTD profiles was reduced with keeping original upper and last levels. Then, depth inversions were detected and unordered levels were deleted. For depth duplicates correction both automatic and expert control was used. The last algorithm applied on observed depths was the elimination of stations with number of levels for temperature or salinity less then three. After depth levels control, the profiles were sent to vertical stability check. The next applied algorithm on integrated database was the checking of variables against range of standard deviations (SD)

computed for a sample selected around an observation. After the QC flags were assigned, the integrated database was ready for vertical interpolation. Applied QC algorithms were intended to preserve the regional variability and to produce a dataset which further can be used for computing of climatology fields with high spatial resolution. The QC procedures were applied on temperature, salinity and oxygen while database contains additional chemistry variables. Instrumental and vertical biases in data were reduced by excluding profiles measured by low accuracy instruments and surface only observations.

Original hydrographic stations are irregularly distributed in space and time while many practical tasks in oceanography and environmental sciences require data represented on regular grid with high resolution. Wide range of geo-statistical methods was developed to solve spatial interpolation problem. It is complicated by non-stationary behavior of oceanographic data when simple methods cannot be applied. As a result there is no common methodology accepted for data mapping in oceanography. To overcome the difficulties and reduce uncertainties most efforts were focused on production of long-term mean climatological fields while variability on different time scales was regarded as noise. We are concentrated on opposite approach where climatological fields are derived from individual grid fields with data type dependent temporal step. Three most common data types in oceanography are repeated vertical sections, horizontal fields and three-dimensional surveys with appropriate time steps. For repeated section it is equal to time difference between consecutive surveys, for horizontal fields most appropriate step is one month. Actually, selection of the data integration step is always a compromise between a depth dependent variable variability and data quantity/spatial coverage.

Geo-statistical modeling of temporally integrated data make high demands for interpolation algorithm. Error of interpolation should be controlled and not exceed natural variability. Different models were tested including ordinary kriging (OK), universal kriging (UK) and global trend modeling. While in some cases UK and global trend modeling get a good results in situations with complicated trend the methods cannot be applied. Intrinsic kriging (IK) model was utilized instead by two reasons. Trends are tested within defined neighborhood prior interpolation and model parameters are adjusted automatically. It is allow processing of large datasets in batch mode. The IK model is embedded into ISATIS commercial software that was extensively used in the study. Kriging standard deviation (KSD) accompanies a variable estimation in each grid point, depends on samples density (relative location) and represents quality of the estimation. The arbitrary selected KSD threshold was used to eliminate grid points with low quality estimations in data scarce regions.

We present an example of dataset for ocean climate change study in the NS. It contains monthly gridded horizontal fields on standard levels in June for 1900-2009 computed on 0.25ox0.5o latitude-longitude grid by means of block variant of Intrinsic Kriging model. Derived climatologies fields can be computed for any period taking into account quality of variable estimations. We use 1957-1990 as a reference period for anomalies computing since most uniform station coverage and good observation quality. Difference between 1900-2009 and 1957-1990 means shows warmer (~0.5o) and saltier (~0.1 psu) conditions for century-long averaging as result of warmer/saltier condition during the first half of 20th century and the late 1990s, early 2000s. Abnormality of each year can be estimated now. Periods with uniform anomalies pattern represent stable hydrographical regime and call for driving mechanisms. Periods with warm/salty conditions during 1958-1963, convection intensification and Atlantic Water sinking during 1967-1972 under strong atmospheric cooling, the Great Salinity Anomaly (GSA) propagation during 1976-1981, mid-1990s low salinity anomaly and generally warm/salty regime after 1998 are most consistent examples of stable regimes in the NS.

Presented methodology of a climatic dataset compilation get access not only to climatological fields representing mean state of ocean variables for a certain period but also to dynamic of spatial pattern of anomalies. Similar datasets can be constructed for any repeated observations along standard sections to access more detailed regional variations. Interpolation method can be improved by utilization co-kriging technique and three dimensional (3D) modeling. The 3D approach gives a chance to skip profiles vertical interpolation which a source of considerable errors. Since unknown amount of observation still not in the public access, more efforts are needed to collect complete initial datasets.

Scalable Sensor Integration in the NSF Ocean Observatories Initiative (OOI)

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The OOI CyberInfrastructure (CI) comprises the integrating elements that link and bind the physical infrastructure into a coherent system-of-systems. The core capabilities and the principal objectives of the OOI are collecting real-time data, analyzing data and modeling the ocean on multiple scales while enabling adaptive experimentation within the ocean. A traditional data-centric CI, in which a central data management system ingests data and serves them to users on a query basis, is not sufficient to accomplish the range of tasks ocean scientists will engage in when the OOI is implemented. Instead, a highly distributed set of capabilities are required that facilitate end-to-end data preservation and access; end-to-end, human-to-machine and machine-to machine control of how data are collected and analyzed; direct, closed loop interaction of models with the data acquisition process; virtual collaborations created on demand to drive data-model coupling and share ocean observatory resources (e.g., instruments, networks, computing, storage and workflows); near-real-time, open access to data with latencies as small as seconds; end-to-end preservation of the ocean observatory process and its outcomes; and automation of the planning and prosecution of observational programs. The CI integration strategy is based on two core principles: messaging and service-orientation. A high-performance message exchange provides a communications conduit with dynamic routing and interception capabilities for all interacting elements of the system-of-systems. The message interface is isolated from any implementation technologies, and provides scalability, reliability and fault-tolerance. Service-orientation is the key to managing and maintaining applications in a heterogeneous distributed system. All functional capabilities and resources represent themselves as services to the observatory network, with precisely defined service access protocols based on message exchange. Services are also defined independently of implementation technologies. Assembling and integrating proven technologies and tools provide the functional capabilities of the CI. While the architecture for the OOI CI was designed to support fixed platforms (e.g. buoys and cabled networks), the control and scheduling of autonomous vehicles provides considerable new flexibility. With the availability of full-time Internet connectivity to US research vessels through HiSeasNet, the CI can provide a powerful transport approach for the background telemetry to and from the ships. We propose to extend the the current HiSeasNet to transport data for use ashore by a wide variety of users and programs (e.g. domain quality control) while minimizing interference with the routine uses of HiSeasNet including VoIP, email and teleconferencing. The integration of research ships into the OOI will greatly expand the program's observing capacity at very low incremental cost.

SeaDataNet regional climatologies: an overview

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In the frame of the SeaDataNet project, several regional climatologies for the temperature and salinity are being developed by different groups. The data used for these climatologies are distributed by the 40 SeaDataNet data centers.

Such climatologies have several uses:

1. the detection of outliers by comparison of the in situ data with the climatological fields,
2. the the optimization of locations of new observations,
3. the initialization of numerical hydrodynamic models.
4. definition of a reference state to identify anomalies and to detect long-term climatic trends

Diva (Data Interpolating Variational Analysis) software is adapted to each region by taking into account the geometrical characteristics (coastlines, bathymetry) and the distribution of data (correlation length, signal-to-noise ratio, reference field). The regional climatologies treated in this work are:

- JRA5: North Atlantic
- JRA6: Mediterranean Sea
- JRA7: Baltic Sea
- JRA8: North Sea, Arctic Sea

Several examples of gridded fields are presented in this work. The validation of the different products is carried out through a comparison with the last release of the widespread World Ocean Atlas 2005.

Permanent Service for Mean Sea Level

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The Permanent Service for Mean Sea Level (PSMSL) is the internationally recognised global sea level databank for long term sea level change information from tide gauges. Established in 1933, the PSMSL continues to be responsible for the collection, publication, analysis and interpretation of sea level data.

The PSMSL was formerly a member of the Federation of Astronomical and Geophysical Data Analysis (FAGS), and is currently being incorporated into the new World Data System (WDS) of the International Council for Science (ICSU). In addition, the PSMSL has close links with the Intergovernmental Oceanographic Commission's (IOC's) Global Sea Level Observing System (GLOSS). Currently the PSMSL databank holds over 56,000 station years of data from over 2,000 stations and in the region of 200 authorities worldwide. Data undergo careful quality control, including ensuring year to year continuity, before addition to the databank. Where possible data reduced to a common datum for time series analysis.

The PSMSL data storage systems have recently been redesigned in order to increase data integrity and take advantage of recent developments in database technology. A suite of graphical user interfaces have been developed to facilitate maintenance and quality control of the database by PSMSL staff. In addition, a new interactive data portal has been designed to enable users to search for and retrieve data from the PSMSL website more easily. Future developments will include improvement of interoperability with other systems.

Global Gridded Bathymetry Data - General Bathymetric Chart Oceans (GEBCO)

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GEBCO's aim is to provide the most authoritative publicly-available bathymetry of the world's oceans. It operates under the joint auspices of the Intergovernmental Oceanographic Commission (IOC) (of UNESCO) and the International Hydrographic Organization (IHO).

The GEBCO community consists of an international group of experts who work on the development of a range of bathymetric data sets and data products, including gridded bathymetric data sets, the GEBCO Digital Atlas, the GEBCO world map and the GEBCO Gazetteer of Undersea Feature Names.

Our latest gridded bathymetric data set is the GEBCO_08 Grid. This is a global terrain model at 30 arc-second intervals. The bathymetric portion of the grid is largely based on a database of ship-track soundings with predicted depths between the sounding points guided by satellite-derived gravity data. Land data are largely taken from the SRTM30 gridded digital elevation model.

To accompany the GEBCO_08 Grid, a 'Source Identifier' (SID) grid has been released. This is a metadata data set which identifies which cells in the bathymetric grid are based on soundings or taken from grids and which are interpolated. It is planned to extend the SID grid coding to identify the individual datasets and surveys used to develop the bathymetric grid.

The grids are freely available to download from the web. Through a map interface and/or dialog box, users can select to download the complete global grid files or data for a user-defined geographic area. Free software is also made available for viewing and accessing the data.

To help with interoperability between data sets, work is underway to develop a version of the GEBCO_08 grid which uses climate and forecast (CF) metadata conventions.

On behalf of the GEBCO community, GEBCO's bathymetric data sets are maintained and made available by the British Oceanographic Data Centre (BODC).

More information about GEBCO: www.gebco.net

Access GEBCO's grids: www.bodc.ac.uk/data/online_delivery/gebco/

The data warehouse OceanDB.

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The oceanographic data warehouse OceanDB has been developed in P.P. Shirshov Institute of Oceanology Russian Academy of Sciences. This oceanographic data warehouse was created to keep data and descriptions of results obtained in the scientific expeditions organized by the by P.P. Shirshov Institute of Oceanology RAS since 1956.
OceanDB provides the structured storage of diverse oceanographic data on the following scientific sections: physics of ocean, ocean chemistry, marine biology and ecology and geology (Table 1). They are including metadata and data. Metadata are structured on 4 levels: expedition, scientific subdivision, station and data. Oceanographic data from different regions of the World Oceans are available as well. As an example the numbers of available large long-term datasets of the Black Sea biological parameters are presented below:

Cruises	Stations	Samples
Phytoplankton	21	344 906
Zooplankton	35	406 596
Macrozooplankton	32	1180 1480

Data covered the period from 1995 to 2009. Most biological data were accompanied by hydrophysical and hydrochemical observations. All data computed and have passed the initial quality control.

The data warehouse provides to users the following services: search and loading of the data, registration and authorized access of users, information representation in various kinds and the analysis of oceanographic data.

To describe the results of field research a data format was developed in XML language. The title of the proposed standard for describing the oceanographic data is OceanML

The data warehouse OceanDB contains the next subsystems: data input, data search, view and download, data analysis.

The data input subsystem provides opportunity to load of data into database by the Internet protocols FTP, HTTP.

OceanDB allows loading of data in real time from various oceanographic sources.

Data input subsystem contains automatic quality control of the data.

System of data exchange is developing now between OceanDB and research vessels directly during expeditions. in SIO RAS.

The data search, view and download subsystem provides access to the information and data warehouse services.

The information is subdivided in two sections: "Expeditions" and "Data". The "Expedition" section contains information of the scientific expeditions with the brief description of their results. The section “Data” contains obtained data sets from expeditions and other sources. Both sections have search services on fields and in a context, spatial and temporal coordinates for a fast finding of expedition descriptions and their oceanographic data sets.

The data analysis subsystem allows displaying set of oceanographic parameters on various graphs. Management service of graphs allows defining of axes X-Y, scaling, changing of format and an arrangement of the legend and other functions. At present the data analysis subsystem and GIS server ArcGIS 9.3 are integrating.

The OceanDB was developed on three-tier architecture. It has the following three tiers: presentation tier, application tier, data tier. The data tier of the data warehouse was developed on Oracle Database Server 10G. The choice has been proved by significant progress of the given platform in a direction of integration XML with technologies of databases. XML DB is option of Oracle Database Server Enterprise Edition.

XML DB allows processing and storing XML of documents directly in the database. It allows to save XML documents in the relational structure and to give access to data by SQL inquiries. In addition it allows to access to data in different way. XML DB allows to access with Direct HTTP protocol, with SQL client, with WEBDAV and FTP clients. XML documents are stored in XML Type Tables.

The application and presentation tiers were developed on platform Oracle Application Server 10G. The business logic has been developed on Enterprise Java Beans technology.

The main feature of the data warehouse OceanDB is a very clear split of dynamic contents and representation.

Data are taken from the database server by SQL and Xquery inquiries in XML format then are transformed by XLST language to HTML or WML in dependence of client browser.

Thus this multi-user access system has been designed for storage, retrieving and analytical processing of scientific research oceanographic data in multi-disciplinary field experiments. The data warehouse has been designed for systematic accumulation of data with the objective of analysis, study and comparison.

Created data warehouse is a convenient information infrastructure for researchers and for application software.

Data Circulation and data management of Sea Surface Salinity Data : the GOSUD project -Global Ocean Surface Underway Data Pilot Project-

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The Global Ocean Surface Underway Data (GOSUD) Project is a project supported by IODE – Intergovernmental Ocean Data and information Exchange Committee of UNESCO. It is designed as an end to end system for surface ocean data collected by ships at sea.

The main objective of GOSUD is to collect, process, archive and disseminate in real-time and delayed mode, all ocean variables collected underway, by research and voluntary ships. During the first period of the Project 2001-2009 priority efforts have been put on sea surface salinity though it is common that sea surface temperature is collected as well and both are managed by GOSUD.

The data reach GOSUD by various means and with different levels of quality. Sea surface temperature and salinity are placed on the Global Telecommunications Systems (GTS), the world wide data exchange network of the national meteorological agencies by ship operators, and GOSUD extracts such measurements from there. A number of the ship operators submit their data directly to GOSUD. Finally, scientific observatories which are part of the project, contribute by providing validated datasets.

The datasets that are submitted to the Project either after a scientific validation or after a quality control performed at the level of a data center are of higher quality than the data that are captured from the GTS. The main reasons are the higher spatial resolution, better and more complete meta-data, more detailed knowledge of the conditions of acquisition (ie calibration coefficients, availability of water samples,…), and scientific or data centre validation.

The data are centralized in the GOSUD database are distributed for scientific studies and are also used for validation of ocean models. A mirror copy of the GOSUD dataset is available at the US National Oceanographic Data Centre. The data system provides two main facilities to access the data. The first is through an ftp site where the data are ordered by year and contributing vessels and made available in the Gosud NetCDF format The second is through a web site where the data can be downloaded either in NetCDF or in ASCII formats.

This paper will describe these elements of the surface underway data system including data assembly from the many sources, quality control procedures applied, replacement of real-time data by the higher quality delayed mode versions, the data distribution system, and some of its users. It will also describe the collaboration with a project for surface underway meteorological observations. Finally, it will provide an analysis of lessons learned, and some insights on future directions.

The Geospatial Interface to the Biological and Chemical Oceanography Data Management System

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The Biological and Chemical Oceanography Data Management Office (BCO-DMO) was created to serve scientific investigators funded by the National Science Foundation's Biological and Chemical Oceanography Sections as a location where marine biogeochemical, ecological and oceanographic data and information developed in the course of scientific research can easily be stored, disseminated, and protected, on short and intermediate time-frames. Our main objective is to support the scientific community through improved accessibility to ocean science data. The BCO-DMO manages existing and new data sets from individual scientific investigators and collaborative groups of investigators, and makes these available via any standard Web browser. This presentation focuses on our implementation of the University of Minnesota's OGC-compliant MapServer interface to these data. One can view the entire data collection in the map view and, from there, access and download data via the text view. In addition, we will highlight the ability to search for data in multiple ways, e.g. by program, cruise, principal investigator, project, sensor/data type, etc. and illustrate mapping and display options including support for KLM (Google Earth) output files. The MapServer interface to the BCO-DMO data collection provides a geospatial context in which to discover data sets that are of potential interest.

Experience in Delivering and Consuming Web Services for Oceanographic, Geoscience and Environmental Data Using a Virtual Globe

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Traditionally datasets of interest to our community have been discovered though text based queries with search engines such as Google, Yahoo, etc. or from browsing specific libraries or repositories, for example, PANGAEA, NOAA's National Geophysical Data Center (NGDC), the World Data Center System, SeaDataNet, the International Oceanographic Data and Information Exchange (IODE), or the Systèmes d'Informations Scientifiques pour la Mer (SISMER). This type of inquiry requires users to have a relatively clear sense of what they are looking for, the time and skills to navigate through individual web pages, and the knowledge to sort through a returned list with a number of potential matches. Once data files are located, users may then need specialized tools or applications to decode the various format and view the contents.

Web services support interoperable machine-to-machine interaction which eliminates the need drill down through a web site. With pre-agreed protocols such as Representational State Transfer (ReST) style communication the services directly access files/documents without intervention. From our experience we have found it useful to assemble catalogues of datasets in xml representation. One updates the catalogues either manually or automatically with new items or for the purpose of deleting those with freshly-broken links.

Automation is made possible with the Open Archives Initiative (OAI) protocol for serving and harvesting metadata. Currently both NGDC and PANGAEA publish their metadata through an OAI web service. It has been possible to bring more than 8000 datasets into our catalogues from these two providers and organize the items under categories such as corals, ice cores, limnology, paleoceanography, spelethems, tree rings, oceanic seamounts, marine geology, deep-sea drilling, etc. Each item has its own geographic bounds so it can be discovered and selected either through keyword search or by location in a map window.

The client-side virtual globe application ingests the catalogues and presents searchable menus, portals and modules to give the user a one-stop "shopping" experience for discovery, visualization and file saving. Tags embedded in the xml code of the catalogues handle the assignments of setting up the web service calls for data and metadata and for delegation of the algorithms for file decompression and format translation.

We will demonstrate at the conference a working version of the catalogue approach with our own Virtual Ocean (www.virtualocean.org) and GeoMapApp (www.geomapapp.org) applications. Additionally we will show some the datasets residing in our own Marine Geoscience Data System (www.marine-geo.org) that we provide via web services. Among our offerings is a hierarchy of tiles for Global Multi-Resolution Topography that is served with a choice of Mercator, geographic and polar projections by means of Open Geospatial Consortium (OGC) Web Mapping Services (WMS). Others include a rich array of measurements on sediment cores and from down-hole logging devices from the Deep-Sea and Ocean Drilling Projects/Program by means of OGC-compliant Web Feature Services (WFS). The latter type of service returns an xml file that is often of a very large size with all of the contents of the service. We will demonstrate at the conference a new "filtering" method using tags within the "GetCapabilities" xml files using the WFS-FE (Filter Encoding) protocol. These tags make it possible for the user to apply a filter to the feature and choose a subset among the available attributes from controlled vocabularies. The choices presented in tags to facilitate listing in pull-down scrollable text windows.

We will also demonstrate our recent implementation of the NASA WorldWind WMS server that returns imagery such ocean surface temperatures, productivity, seafloor age, seafloor magnetic anomalies,

coastal charts, etc. in a much more computationally efficient and faster process that the traditional WMS server. It has been feasible to package all of our catalogues and hosted datasets on a portable hard drive and send the drive to sea on research vessels for remote operation of our virtual globe application without connection to the external web. This sea-going capability allows for real time cruise planning and decision-making with the advantage of having the existing (historical) data within the region of the on-going survey.

Representation biodiversity and bioresources information for marine data centers

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The development of the thematic scientific databases is a problem-oriented task with a specific application for different categories of users. The Severtsov Institute of ecology and evolution, Russian Academy of Sciences (http://www.sevin.ru) has several data portals in the framework of related scientific projects: "Fauna and Flora in Protected Natural Areas of Russia", "Vertebrates animals of Russia", "Red Book species of Russia", and "Alien species of Russia". The portals allow the following functional possibilities: browse mode for navigation, query mode for the choice of the species of a particular interest, and full-text contextual search mode. The database in the Severtsov Institute is collected by a special research group and is managed by originally developed software. "Data and information access on Distribution, migration and stock abundance of the Caspian sturgeons", "Field surveys of fish data", and "Remote sensing data on primary production and biological resources distribution in the Caspian Sea basin" has not yet completely implemented via web-portals. These circumstances provoke to use services of data centers.

Marine data centers provide universal services for searching and overview of the oceanic data and information. This efficiency is reached by the application of state-of-art technology with centralized metadata repository, network of data centers and access via data portal.

In the Severtsov Institute the items of database are presented by means of a list of species, their distribution, abundance and life history. Data centers advance some claims for data and metadata. The major steps of work include referencing with vocabularies and data dictionaries, acquisition and restoration of missing attributes, georeferencing, data reformation and after-treatment, changing products level and view. The technical realization is based on the application of geospatial methods, digitizing of historical data and printing works, and statistical analysis using suitable software and provided by data centers utilities and services. The presented results are obtained in the framework of CASPINFO project and SeaDataNet services.

GIS database as the basis for establishment of a Marine Protected Area (MPA) The Small Phyllophora Field in Karkinits'ka Gulf, Black Sea, Ukraine

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Phyllophora are a group of red algae that has commercial value for harvesting and extraction of agaroids. It also forms an important source of oxygen resulting from the photosynthesis performed by the field. In addition, Phyllophora fields in the northwest Black Sea have associated with them specialized faunal communities including more than 110 species of invertebrates and 47 species of fish. The world's largest area of Phyllophora, Zernov's field, once covered some 11,000 km2 of the northwest shelf of the Black Sea and had a biomass of 7 – 10 million tons. By the early 1990s, the algal field had shrunk to 500 km2 and its biomass to under 0.5 million tons. The Small Phyllophora Field (SPF) of some 300 – 400 km2 area is located to the east of Bakal's'ka Beak and Bakal's'ka Banks in the shallow inshore part of Karkinits'ka Gulf. This area has been included in the Ramsar List of Wetlands of International Importance. The key species of the SPF is the red alga Phyllophora crispa sphaerica the state of which is more or less stable. The SPF is the eastern analogue of Zernov's Phyllophora Field (ZPF) lying on the north-western Black Sea shelf south south-east of Odessa. In contrast to the ZPF, the SPF has a number of distinctive features associated with its coastal location, and a significant number of species remain which have disappeared from the ZPF. In the SPF the water is very transparent and hypoxia has not been observed. As a result, the Small Phyllophora Field (SPF) in Karkinits'ka Gulf has assumed greater importance for conservation and ecosystem management.

In order to prepare the proposed MPA documentation it was necessary to produce accurate digital maps of the site, with various thematic layers that could be superimposed for additional analysis as well as modeling purposes (e.g. any potential effects of sea-level rise from global warming).

All available digital geographic information about Karkinits'ka Gulf was collated in a number of layers using a Geographic Information System (GIS). The layers were derived from official marine charts, as well as information collected from previous internationally-funded projects (e.g. BSERP, BSEP, and PlanCoast) and satellite imagery (including a link to Google Earth). This exercise produced the most comprehensive geographic data set ever assembled for Karkinits'ka Gulf .

In addition, the EEA pan-European 50 x 50 km chorological grid for biodiversity monitoring was

superimposed on the study area, and broken down to show sub-units of 10 x 10 km, 2 x 2 km and 1 x 1 km. Each cell was numbered and cross-referenced to the geographical coordinates. There were 14 of the 10 x 10 km cells which were used as the basis for field sampling.

Following the completion of the Field Survey of Karkinits'ka Gulf in September 2008, the geographical information on the distribution of benthic macrophytes, especially Phyllophora crispa, was digitised and incorporated in the GIS.

In addition CMS 7 (Conservation Management System) – sophisticated and customizable database with integrated mapping (GIS) option, which provides a logical and flexible structure, to help in preparation of high quality management plans for conservation and recreation areas, is implemented.

The GIS was used to generate new synoptic maps of the Small Phyllophora Field for the project experts, Ministry of Environmental Protection of Ukraine, local administrations and decision makers, as well as a simpler version for use in public information materials.

R2R: Managing Dataflow from a National Fleet of Research Vessels

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The Rolling Deck to Repository project (R2R; http://rvdata.us) is beginning to systematically manage the routine underway dataflow from the US academic fleet of 30 vessels, with approximately 500 research cruises per year. R2R has established a working central shoreside data hub, to which more than 3.7 million data files have been uploaded from 1053 cruises on 15 vessels in less than 2 years of startup activity. In this poster we report on dataflow challenges and solutions. Related presentations by Carbotte, Miller and others, provide an overview of the R2R project and details on quality assessment.
The technical design for R2R is guided by several key principles:

1) The data pipeline is modular, so that initial stages (e.g. inventory and review of data shipments, posting of catalog records and track maps) may proceed routinely for every cruise, while later stages (e.g. quality assessment and production of file-level metadata) may proceed at different rates for different data types;

2) Authenticated cruise documentation is made available for processing scripts and for user access, including sailing orders, review/release of data inventories, and vessel profiles. The information is gathered primarily via an authenticated Web portal, linked with the fleet wide scheduling database to synchronize vocabularies and eliminate redundancies; and

3) Every data set is documented and delivered to the appropriate National Data Center for long-term archiving and dissemination after proprietary holds are cleared, while R2R maintains a master cruise catalog that links all the data sets together. This design accommodates the diversity of instrument types, data volumes, and shipment schedules among fleet operators.

Cruise level metadata, track maps, and data inventories are published at the R2R Web portal (http:/rvdata.us/), with controlled vocabularies drawn from community standards (e.g. International Council for the Exploration of the Sea (ICES) ship codes). A direct connection has been established to the US University-National Oceanographic Laboratory System (UNOLS) Ship Time Request and Scheduling System (STRS) via Web services to synchronize port codes and cruise schedules.
The R2R underway data type categories have been defined in collaboration with the vessel operators, and presently include: ADCP, CTD, echosounder, expendable probe, fluorometer, gravimeter, magnetometer, meteorology station, multibeam, navigation and pCO2, SSV, subbottom, TSG, and winch. It is important to note that there are data types that R2R will not address. For example, the chief scientist will continue to be responsible for the documentation and archiving of data from specific instruments that are brought on board by the scientific party and are not part of the ship's standard equipment. Similarly, data collected with National Facility assets including the National Deep Submergence Facility (NDSF), Ocean Bottom Seismograph Instrument Pool (OBSIP) and the National Marine Seismic Facility (NMSF) will continue to be submitted to the appropriate archiving facility directly by those facilities, rather than through R2R.
As a first pass the data are inventoried and raw distributions are stored in an independent deep archive. This assures that the original data are recoverable in case of data loss or corruption by an operator, Chief Scientist, or data center. A second pass breaks out the individual data types by instrument. This will include a detailed vessel profile per ship. A third pass on the data will assess the

quality of a subset of the data types and store this information as a quality certificate. The final step is to create persistent unique identifiers and disseminate the data to existing National Repositories and Data Assembly Centers.

One of the key challenges to the project is that shipboard data distributions are submitted by 18 different operating institutions, with varying procedures, media, traditions, standards, naming conventions, suites of instruments, and proprietary restrictions. In each shipboard distribution we find that the desired routine underway datasets are embedded in diverse directory structures, aggregated in various fashions, and surrounded by temporary data files, generally undocumented previous versions, and various other documents that may or may not be useful for further processing and use. We have adapted automatic processing scripts from other projects to extract the required files, and to harvest metadata from the files.
The cruise-level metadata profile and a suite of controlled vocabularies are critical for the success of the automated harvest process. The metadata profile for each cruise includes the R2R cruise identifier, vessel name, ports, dates, instrument information, scientific party names and institutions, etc, all drawn from controlled vocabularies as much as possible. In addition, the metadata profile will provide specific information about cruise distribution directory structures, filenames and aggregation practices for each R2R routine data set, for use by R2R auto-harvesting scripts. This capability will allow the staging scripts to adapt to distribution directory structures and practices of the various operating institutions, or as the project evolves.
In addition to the extraction of selected underway datasets, R2R is responsible for the production of a suite of standard products to be generated for each cruise including (1) Basic Cruise Metadata, (2) Operations Report, and (3) Quality Controlled Navigational Products. Certified R2R navigation will be created at three levels: NavHiRes at the original raw sample rate (usually one sample per second), Nav1Min at a standard 1-minute time interval, and NavControl at a reduced rate appropriate for graphical representation of a cruise track at a global or regional scale. These R2R standard data products will be made available for automatic harvesting by repositories, and for download by individual users.

Funding for the five-year multi-institutional R2R program comes from the US National Science Foundation (NSF) Oceanographic Instrumentation and Technical Services Program.

APDRC: Providing web services for climate data and products

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The International Pacific Research Center (IPRC) at the University of Hawaii (UH) maintains a data center for climate studies called the Asia-Pacific Data-Research Center (APDRC). This data center was designed within a center of excellence in climate research with the intention of serving the needs of the research scientist. As the APDRC has developed, the wide collection of data, ease of access, and integration of different data services has produced a valuable research tool for a more wide variety of users. The APDRC maintains an archive of in-situ and remote data, as well as a range of model-based output. All data are available via on-line browsing tools such as a Live Access Server (LAS) and DChart, and direct binary access is available through OPeNDAP services. The primary users of the APDRC initially were climate scientists, and the services awere therefore streamlined to such users, both in the number and types of data served, but also in way data were served. On-going efforts are to broaden the user-base. Finally, due to the integration of the APDRC within the IPRC, several value-added data products have been developed via a variety of research activities. The APDRC, therefore, has three main foci:

1. acquisition of climate-related data,
2. maintenance of integrated data servers, and
3. development and distribution of data products

These three components of the APDRC will be described in more detail in this presentation.

1. APDRC Data Holdings

The APDRC presently has approximately hundred (100) data sets including in-situ, remote/satellite and model output. Data come from a variety of providers, and some are served through the APDRC servers but not physically stored on the system. In these cases, the APDRC provides aggregation or, in some cases, reformatting to allow easier access to the data. At present, the APDRC holdings include about 30 model or model-based reanalysis products, 24 datasets based on in-situ measurements and 31 based on satellite measurements. Some notable data holdings include over 70TB of global ocean model output from the Earth Simulator Center at JAMSTEC (OFES), daily downloads of high-resolution operational model output from the US Navy (NLOM/NCOM/HYCOM) and near-real time data from different satellite platforms.

2. APDRC data servers

The APDRC data system is built around the Open-source Project for a Network Data Access Protocol (OPeNDAP). At present the APDRC uses three different OPeNDAP-based servers. One is based on the Thematic Real-time Environmental Distributed Data Services (THREDDS) developed at Unidata. Another is based on the Grid Analysis and Display System (GrADS) developed at IGES. The THREDDS DODS Server (TDS) and the GrADS DODS Server (GDS) are mainly used for gridded data, and each provide different functionality for data aggregation, remote services and data formats. Finally, the APDRC uses Dapper, mainly for in-situ profile and timeseries data. Dapper was developed at NOAA's Pacific Marine Environmental Laboratory (PMEL).

Web-based browsing, sub-setting and plotting/downloading are provided through two different servers: Live Access Server (LAS) and DChart. These servers were developed by separate groups at PMEL and allow users to query data sets either spatially and/or temporally, make plots on-the-fly, and

optionally download data. Originally LAS was used for gridded data and DChart for station data, but now both provide these capabilities.

3. Example data products

In addition to the data archive and servers, the APDRC maintains a growing list of data products and projects. Working with scientists in the IPRC and elsewhere, the APDRC provides a mechanism for distribution of scientific results and derived data products. In addition to our data servers, Google Map API and Javascript are used to provide plots and links to data.

Some data product examples include:

- Near-real time, globally unified research quality datasets derived from Argo float profiles and trajectories with the concurrent use of satellite and in-situ data.
- US CLIVAR/CO2's vertical profiles of horizontal velocities from Lowered Acoustic Doppler Current Profiler (LADCP)
- Statistical down-scaling of IPCC climate model results for the Hawaiian Islands

The APDRC can be found at http://apdrc.soest.hawaii.edu. The presentation will provide an overview along with specific examples of the data, data products and data services available at the APDRC.

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POGO International Research Cruise Information System

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The Partnership for Observation of the Global Oceans (POGO) International Research Cruise Information System provides a new tool for ocean scientists to become more efficient in cruise planning, instrument deployment, and servicing of moorings. POGO members operate a fleet of ocean-going research vessels which undertake scientific cruises in the world's oceans. Recognising the need to improve information sharing for planned, current and past cruises and on details of ocean-going research vessels, to enhance awareness of opportunities, to improve cost-effectiveness of cruises, and to improve data mining opportunities, POGO together with the Census of Marine Life (CoML) and National Oceanic and Atmospheric Administration (NOAA) undertook the initiative to set-up an International Research Cruise Information Database and related website from the perspective of international programmes and initiatives.

Potential benefits from such an international cruise database include:

- Helping scientists from different countries coordinate future funded research through information about research vessels of opportunity
- Aiding in retrospective ability to find data in regions of interest
- Making it possible for projects to conduct joint work and to fill empty berths
- Creating capacity-building and training opportunities
- Aiding in tracking and distributing data
- Providing information to evaluate the benefit of observations from ships as part of GOOS
- Making it possible for scientists and operational users from other projects to get instruments deployed and/or samples taken in hard-to-reach areas of the ocean (e.g. drifters, profiling floats, moored buoy servicing)
- Allowing cost sharing among institutions, projects, and nations
- Making possible intercomparisons, intercalibrations, validation among different data types (e.g. CTD vs. Argo, in situ vs. remote sensing)

A committee of interested parties formed by POGO developed specifications for an international Research Cruise Information System. Implementation has been carried out by a subgroup of SeaDataNet partners (consisting of the British Oceanographic Data Centre (BODC), the Marine Information Service (Maris), Netherlands, Bundesamt für Seeschifffahrt und Hydrographie (BSH), Germany, and EurOcean, Portugal). These organisations are primarily responsible for the development, technical operation and maintenance of the website and databases. The provision of new information (i.e. content) and updates of that information is the task of the POGO members, vessel operators, NODCs and chief scientists, making use of the mechanisms provided.

The international Research Cruise Information System (www.pogo-oceancruises.org), initially created in 2007, includes three databases for oceanographic research vessels and cruises:

1. Worldwide research vessel characteristics
This database currently includes over 150 ocean going research vessels, which can be searched by vessel name, country, length, main activities (e.g., oceanography, fisheries, multiple activities, education, and ice- going operations), and whether the vessel is available for charter.

2. Planned research cruises
This database currently includes research cruises worldwide for and can be searched using pull-down menus, free searches, or search criteria such as whether there are any empty berths on any ships. Searches can be delimited by selecting an area on a global map or by specifying latitude and longitude ranges.

3. Cruise summary reports (CSRs)
A special version of this database has been developed for all oceangoing vessels longer than 60 meters (the size criterion is nominal; the emphasis is on capability for extended cruises). Chief scientists on the cruises are invited to submit their CSRs online and thus maintain an up-to-date overview of past ocean cruises. This database could be an important resource for research projects, to make it easier to track and access data from past project cruises.

These have been developed building upon SeaDataNet where possible, and, in particular, make use of the standards, infrastructure and common vocabularies developed by SeaDataNet.

The new 'EUROFLEETS - Towards an alliance of European research fleets' FP7 project brings together a significant group of key marine research actors (in particular research vessel operators) in Europe. It includes a work package to improve information sharing on planned, current and completed cruises and on details of ocean-going research vessels and specialised equipment owned by the EUROFLEETS beneficiaries, to enhance awareness of opportunities among the beneficiaries, and to durably improve cost-effectiveness of cruises. This will build upon and enhance the POGO international Research Cruise Information System, utilising the developments already undertaken.

Initial Progress in Developing the new ICSU World Data System (WDS)

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On October 24, 2008, at the 29th International Council for Science (ICSU) General Assembly in Maputo, Mozambique, a decision to form a new ICSU World Data System (WDS) was taken. The new ICSU World Data System (WDS) will replace the framework within which the current ICSU World Data Centers (WDCs) and services of the Federation of Astronomical and Geophysical data-analysis Services (FAGS) are currently organized. The transition from the old organizations to the new WDS was facilitated by the ICSU ad-hoc WDS Transition Team which developed a white paper with recommendations for the new WDS Scientific Committee (WDS-SC). The WDS-SC was appointed by ICSU and reports to the Executive Board and the General Assembly of ICSU. The WDS-SC met for the first time in October 2009.

WDS-SC shall be the governing body of WDS with the following tasks:

1) to ensure that the WDS clearly supports ICSU's mission and objectives by ensuring the long-term stewardship and provision of quality-assessed data and data services to the international science community and other stakeholders;
2) to develop, and keep under continuous review, an implementation plan for the creation of the WDS by incorporating the ICSU WDCs, the Services of FAGS and a wide range of other data centers and services;
3) to define agreed standards, establish and oversee the procedures for the review and accreditation of existing and new facilities;
4) to monitor the geographic and disciplinary scope of the system and to develop strategies for the recruitment and establishment of new WDS facilities as necessary;
5) to consider resource issues and provide guidance on funding mechanisms for facilities within WDS when appropriate;
6) to develop strong cooperative links with the ICSU Strategic Coordinating Committee on Information and Data (SCCID);
7) to cooperate closely with the ICSU Committee on Data for Science and Technology (CODATA).

WDS development will proceed from these initial concepts: history and legacy of the WDC and FAGS systems; definition of the nature of the WDS within ICSU and the scientific community; preliminary scoping and scaling of the system based on the number and types of scientific organizations interested in participating; motivating stakeholders and implementing a community of practice for WDS components; and, defining the accreditation and certification of these components.

To be successful, the WDS will need to be interoperable with existing data systems, employing both existing and emerging technologies, and to develop and test new operational structures -- e.g. a "Global Data System of Systems".

Establishment of a National Oceanographic Database and Information System in Taiwan

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Taiwan is surrounded by the sea, various types of oceanographic data have been collected to meet the needs of government agencies, marine industrial organizations and ocean research institutes. Though many universities, research institutes, industrial organizations and governmental agencies have engaged marine investigations and ocean observations for a long time, a comprehensive national oceanographic data center has not been established in Taiwan yet. It is clear that an ocean data network as a virtual data center which can play the role of a national data center should be established first. Data acquisition standards, QC procedures, and data interoperability from various databases are important issues to be discussed. In addition, an information portal on ocean sciences and technology is highly desired by the ocean research community in Taiwan.

In September of 2008, the Taiwan Ocean Research Institute (TORI) was established under the National Applied Research Laboratories, and took the task of establishing a national oceanographic database and information system. That, in the future, will integrate all the major oceanographic databases in Taiwan into one platform, the Taiwan Ocean Data network (TODnet). The suggested system will consist of a centralized metadatabase and many distributed physical databases linked via networks. The first step is to gather and integrate metadata from several participating oceanographic databases and to build a proto type virtual ocean data center.

Several databases including Marine Meteorology Database, TaiBNET, Ocean Databank, and Harbor Oceanic & Meteorological Database that are either managed by governmental agencies or universities have contributed their metadata to TORI for the establishment of an United Catalogue. Currently, TODnet metadatabase consists of 14 tables and can be simply queried and displayed by user-friendly interface of Google Maps API. Actually TODnet will not only provide transparent search and service requests on metadata, data and product of various oceanographic databases in Taiwan, but will also be responsible for preserving and managing TORI's own oceanographic database including shipboard, remote sensing, coring, habitat mapping, marine time-series observation, ocean observatories and coastal monitoring data. In addition, oceanographic data from foreign databases that cover the seas around Taiwan, such as NODC's GTSPP database, are also to be integrated into the system so one can access data information of the cooperative international data repositories from a single search point.

TODnet is currently a working prototype platform with four partners and one centralized metadata catalogue. Distributed database system is under planning, and we welcome international cooperation on data, information and technical exchanges.

The CNR-ISAC informatic infrastructure for the Climatological and Oceanographic data production, validation and sharing, based on open-source technology in a Grid environment.

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CNR-ISAC-GOS is responsible for the Mediterranean Sea satellite operational system in the framework of MOON Patnership. This Observing System acquires satellite data and produces Near Real Time, Delayed Time , Re-analysis and Climatological data of Ocean Colour and Sea Surface Temperature products covering the Mediterranean and the Black Seas. In the framework of several projects (MyOcean, PRIMI, Adricosm Star, SeaDataNet, ECOOP, GIIDA), GOS is producing Climatological datasets based on optimal interpolation and Regional-specific algorithm for chlorophyll, updated in Near Real Time and in Delayed mode.

In the framework of SeaDataNet, the GOS has tested Variational (DIVA software) technique in order to produce Climatological datasets and make comparison with Optimal Interpolation Climatological datasets

GOS has built

- an informatic infrastructure data repository and delivery based on THREDDS technology
- The datasets are generated in NETCDF format, compliant with both the CF convention and the international satellite-oceanographic specification (INSPIRE, EN-ISO19119,EN ISO 19115, EN-ISO19139, etc…)
- All data produced are made available to users via a set of open-source web services as: THREDDS server catalog, LAS, WMS, Gi-Cat
- a Grid Environment based on Globus Technologies (GT4) connecting more than one Institute; in particular exploiting CNR and ESA clusters makes possible to reprocess 12 years of Chlorophyll data in less than one month.(estimated processing time on a single core PC: 9months).

In the poster we will give an overview of:

- the features of the above tools pointing out the strength of THREDDS for data sharing and retrieval
- the Grid infrastructure on ISAC
- the importance of adopting a common format (as NETCDF) for data exchange;

We will present also specific comparison between DIVA and OI climatological data.

Real-time collection of several marine data types by automatic population of relational databases, granting interoperability and resilience.

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This work is focused on the development of a prototype produced in the framework of the service for the management, maintenance and implementation of the local meteo-marine network for the Civil Protection of Friuli Venezia Giulia. It allows the real-time collection of several marine data types by automatic population of a relational database, granting interoperability and resilience.

In particular, we tried to join the OGS Oceanographic Department different expertises in marine data collection, calibration and validation, archiving and dissemination developed during a long time period of field activities .

Within this collaboration we are realizing a real-time data management system with the automation and optimization of the entire data handling process: from the measurement of raw data to the end-users use. Currently this solution represent the best answer to cut down the time needed to the harvesting of multiple data formats, the conversion in a homogeneous and standard format, the structuring in a database and the validation.

The requirements of interoperability, as ability to cooperate and exchange information, and resilience, as ability of adaptation to new needs or to unforeseen, directed our technological choice.

The XML is a standard de facto that guarantees interoperability. It is the core of the java library “ServingXML” that allows to understand and to convert textual data through the directives present inside an XML file (adding one for each input flat format).This conversion generates a new XML file which schema we have defined following standardization and conciseness criteria. The nature of this schema allows to describe all kind of information of our interest. The use of java language guarantees the platform independence.

The adoption of a middleware infrastructure like an ESB (Enterprise Service Bus) grants the resilience operating in an event driven way, decoupling software services. The Bus is responsible for the quality of service features such as message persistence, guaranteed delivery, failure handling, and transaction support.

The data structure coming from the storage in a relational database allows wide data-warehouse and analysis (data-mining) opportunity, granting capability to reach a wide end-user-needs spectrum.

Inspired by its working experience at European level the Italian NODC is building, in collaboration with other OGS groups, this technological infrastructure. At the moment the work is following the needs coming from the management of an already existent meteo-marine monitoring network, maintained for the local Civil Protection agency. The data comes from a wide range of instruments like: two current profilers positioned on the river mouths to monitor the river flow rates, three meteo-oceanographic buoys with a meteorological station and a CTD profiler, three directional wave riders buoys with a satellite positioning systems .There is the clear intention and hope to meet other international institutions interests for future co-operation and joint developments.

A Web-GIS Interface for an Integrated In-situ Ocean-Data and Information System

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The present study focuses on the Web Map Service (WMS), which is being integrated with the vector data available in the in-situ oceanographic data at the Indian National Centre for Ocean Information Services (INCOIS). WMS enables the creation of Web maps that have layers coming from multiple different remote servers/sources/platforms, which are used to integrate data from heterogeneous in-situ platforms, enabling easy access to end users. In this paper, we describe our efforts to implement GIS services according to Open Geospatial Consortium (OGC) standard specifications. Using web services, the integration of GIS services with the operational services like information and data management is discussed.

Introduction

Since its inception, INCOIS has been a central repository for ocean data and provides various ocean information and advisory services in India. The data centre at INCOIS receives voluminous data from various in-situ platforms including: moored buoys, drifting buoys, expendable bathythermograph (XBT), tide gauges, automatic weather station (AWS), etc. (see Figure 1) in real time as well as in delayed mode. In order to provide the data services, a WebGIS framework was conceived as the optimal way for exchange of data amongst large number of participating users, as discussed in the following sections.

WebGIS Building steps

The implementation plan for building an operational WebGIS can be segregated into two phases:

1. Integrated Database Management System (IDMS)
2. WebGIS with user interactive functionality

The comprehensive IDMS involves end-to-end process from data acquisition to data dissemination. The system is all inclusive, as it imbibes data from wide array of sources like: real time satellite communication, emails, FTP, VSAT and offline data in form of CD and etc., in different data formats, with different acquisition characteristics and efficient metadata handling. With these broad requirements and system needs, it becomes imperative to evaluate existing database managements systems (DBMS) and available software languages and tools, which also supports University of Minnesota (UMN) MapServer [REF]. Such an evaluation exercise for the IDMS led to the MySQL as database server, thus giving us the required spatial functionalities, user interaction and effective web delivery.
The second step involves the implementation of common WebGIS interface which can interact with all sorts of data and finally it involves testing its efficiency and effectiveness and consequently to improve data processing software settings and implementation and web site page design.

The WebGIS Components

After all the data sources are been processed and stored, now it's time to define the structure of WebGIS and how information flows in it. An integrated in-situ data web GIS is formed by five following components:

- UMN MapServer
- Apache Tomcat
- MySQL
- ChartDirector
- A Browser

The MapServer and a browser is enough to implement a Web GIS; in fact, MySQL is used to store in-situ data in database tables in simple vector form which can be directly loaded by the GIS engine.

MapServer and other web interfaces

University of Minnesota(UMN) MapServer is an open source program, it acquires and processes requests coming from the user and returns him output results. It already supports several OGC Web specifications, including WMS (Web Map Service), non-transactional WFS (Web Feature Service) and GML (Geography Markup Language). MapServer consists of three different components:

- The map file,
- The template files.
- The CGI program

The Mapfile is the heart of MapServer. It defines the relationships between objects, points MapServer to where data are located and defines how things are to be drawn. This is a built-in object oriented scripting language in MapServer, which defines how to create and use the maps and their layers. In particular, in the map file Layer Objects the paths and connection types to data load are specified. OGR connection (by OGR library) is used to connect the database in MySQL and web GIS.

Template files are used to define the look of a MapServer CGI application interface and to provide the results of the query. They guide the presentation of results, either a query or a map, to the user. This are common HTML page provided with MapServer specific parameters and variables and can be view by browser.

CGI program provide standard protocol to interfacing browser and web server, it reads and processes both the map file settings and the template file, user defined variables and returns the processed outputs as maps, variables or values and query results shown in the template files. Every CGI output is a temporary image or value updated at each CGI work session.

ChartDirector, commercially available software has been used in presenting the data plots for resulted data layers, which is a professional chart component for web applications. Java Server Page (JSP) program is used for accessing the time series as well as profile datasets from MySQL database to display the charts using Chart Director.

MySQL and their interaction with MapServer

The geo-referenced data from different sources are stored in MySQL tables. WebGIS loads these data to be displayed in the maps as any other MySQL client. For loading these data from the database it is enough to specify following parameters in a mapfile Layer Object:
- the connection parameters, in particular the name of the database containing the table to be loaded, user name and password.
- the name, the table and its geometry column.
- the filter with the syntax user for a SQL query WHERE clause.

The WebGIS Structure and functions

From the home page the user can choose the data sets to work with or on which he/she is interested. Following datasets are integrated in web GIS as layers:

- Drifting buoy
- Moored buoy
- Automatic Weather Station
- XBT
- Wave rider buoy
- Current meter array

• Tide guage

User may interact with GIS engine via Web Server for Map viewing or Web server for viewing plots related with data sources. The figure 1 represents the work flow of web interface:

- Map viewing or querying parameters setting
- MySQL data loading setting
- MySQL georeferenced data return
- Map views or query results displaying
- Chart viewing or querying parameters setting
- Chart views or query results displaying

User can work with the proper MapServer template files and in particular he can use these provided functions:

- Data source (Layer) selection
- Map browsing (pan, zoom in, zoom out, predefined views)
- Map queries (multiple queries)

Query functions are especially useful for getting the availability of data from different sources for selected region. User may get the information regarding all the available platforms in a interested region based on which the web interface allows other queries to dig out into the dataset.

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The value of web-based plankton atlasses: experiences with halocyprid ostracods

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Two web-based atlases for halocyprid planktonic ostracods have recently been published on the web, one of the Southern Ocean http://deep.iopan.gda.pl/ostracoda/, and the other for the Atlantic: http://www.nhm.ac.uk/research-curation/research/projects/atlantic-ostracods/index.html

based on compilations of published georeferenced records and enhanced with unpublished results. Planktonic ostracods, despite their ubiquity in oceanic water columns, are neglected partly because of their relatively small sizes, but also because of the problems with access to the taxonomic literature dedicated this group of animals.

The sites have been designed to provide both taxonomical and zoogeographical resources for all oceanographers and biogeographers with access to the web. Features they include are: 1. Up-to-date global species listing; 2. A regional species list; 3. An illustrated guide to the morphology of the species; 4. A comprehensive bibliography of the group. The regional listing links to pages with an outline diagram of each species and offers three further options: a) distributional maps; b) standardized diagrams; c) notes on the systematic of the species together with size data. 66

The Atlantic website also includes bathymetric profiles, which are available for about half the species. The distributional maps based on positive observations are prone to errors of identification and systematic confusion. Disjunct distributional ranges often indicate taxonomic confusion, and have already resulted in both the revision of existing species and description of the new species.

A plan for one more web-based atlas describing Svalbard pelagic ostracods has been produced. More comprehensive information, e.g. detailed description of the investigated area and the influence of hydrological conditions on distribution of each species occurring in Svalbard waters, will be an important benefit in comparison with the previous atlasses.

Marine Data Management in NIMRD Constanta Romania; its relationship with Marine GIS database in support of data access and sustainability, at national level

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The marine data management actions in NIMRD “Grigore Antipa”, Constanta, Romaina, developed towards implementation of SeaDataNet standards/QC-QD procedure/software/web-services, are supported by complementary systems, among others areas, for processing marine and coastal geospatial data. There is a working relationship/effort to make the interoperability of data, between different internal departments and several national organizations, despite of the inertia in assimilation of the international standards/specifications.

This paper presents the certain national actions that are developing as an implementing activity of best international/and especially European practices developed within SeaDataNet Project, on the use of marine data and metadata standards in the marine domain. In connection with these, Web-GIS services are at the moment one of the most growing sectors in geographical information system science, and one of the goals of this work/paper is to evaluate the strengths of implementing SeaDataNet standards in correlation with a Web-GIS system as a support tool for Operational Oceanography, Marine Integrate Planning and also Coastal Zone Management Plans.

The challenge analyzed on this work is the construction of a Marine GIS able to accommodate the data exchange and integration, from several sources/teams.

A complete data recording and reporting system for the EU commercial fishing fleets

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With the advent of satellite communication systems and broadband on larger vessels the sending and receiving of activity reports from the fishing vessels has become a more manageable task and it became apparent that more modern means should be utilised for the collection and reporting of data from active fishing operations.

The EU has been involved in the development of the e-logbook for some time and with the commencement of the EU SHEEL project (Secure Harmonised Electronic Logbook) in 2004 the intention was clear- a transition from the archaic paper based logbook to a digital version was not far away. On the 3rd of November 2008 the EU commission published a set of regulations ((EC) No 1077/2008) laying down detailed rules for the implementation of Council Regulation ((EC) No 1966/2006) on electronic recording and reporting of fishing activities and on means of remote sensing and repealing Regulation ((EC) No 1566/2007).

According to (EC) No 1007/2008 as of the 1st of January 2010 all European Union fishing vessels above 24 meters are obliged to have an e-logbook installed and reporting on a 24 hour cycle for the duration of the fishing trip. By mid 2011 the 15 meter and above sector should follow suit. In relative terms the decision to implement the e-logbook has moved quickly. The complexity of EU regulations governing fisheries is a daunting challenge and to design an e-logbook system that encompasses these regulations and keep the fishing industry on side cannot be underestimated. In addition it became apparent that many EU states do not have the means, neither the technology to receive and disseminate active fishing trip reports in “near-real-time” environment as required by (EC) No 1077/2008.

Olrac, a South African company, developed a comprehensive Elog system specifically for the requirements of the EU commercial fishing community. The system, developed by Olrac, includes an onboard client version (Olfish Dynamic Data Logger) and a web-based data management hub (Olfish Reports Management System).

The web hub system is a complete system for the management and dissemination of reports (catch, landing, vessel movement, sales and transhipment) received from fishing vessels or entered directly when relevant. While Olfish-RMS was constructed according to the EU regulation (EC) 1077/2008 it has been designed to allow its scope to broaden to include other national data and reporting needs. Olfish-RMS is deployed on an MS Windows Apache server running PHP version 5 and MySQL Version 5.

The Olfish-RMS consists of 2 components: A web-based interface (WebViewer) and a communication module (MailPuller). The web-based interface is controlled by user access control. These are: a) Administrator who has complete control to add/edit/delete data on the system as well as viewing of aggregate data. b) Inspector who has access to add/edit/delete data related to EU reports and the viewing of lookup fields as well as the viewing of aggregate data, c) vessel user which allows the vessel owner/master to view all reports submitted by the vessel and d) member state which allows other member states to view landings when this occurs in their waters, as well as prior notification reports to their ports.

The communication module of Olfish-RMS (MailPuller) is configurable to connect to any SMTP server account dedicated to the receipt of electronic reports from Vessels and First Sale units as well as other member states. The MailPuller also scans all incoming messages, and where relevant (according to regulation EC 1077/2008) forwards landing and prior notification reports to other member states. The configuration of which member states send to is done from within the Olfish-RMS web interface. Once incoming reports have been validated, they are imported into the Olfish-RMS MySQL database. If

validation fails, a failure report is sent back to the sender. If the report is imported, a success acknowledgement is sent back to the sender.

If required, inspectors can manually add report data. This may be necessary due to the failure of onboard systems or for vessels that have not yet adopted an onboard reporting system. Inspectors are also able to enter comments on any submitted report and reports are marked as pending until they are accepted by an inspector.

Olfish-RMS allows the user to view reports on an individual level (in their original format) as well as aggregated reports based on imported data. The system also allows for the import of corrected data as per EU regulation (EC) 1077/2008. Vessel location and summary data can also be viewed spatially, using Google Maps. Olfish-RMS facilitates data cross-checking, system status, data validation and the conditional dissemination of data and reports to other member states as dictated by EU regulations. Olfish-RMS is also preconfigured with all lookup values as specified by (EC) 1077/2008.

Olfish-RMS allows the user to swap between languages. The interface, as well as all lookup values, change based on the language selection. Olfish-RMS is able to export all lookup data and reports to Excel and Word.

The deployment of cutting edge data logging and data management technology for seabird conservation: A Case Study

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Albatrosses are amongst the worlds' most endangered bird groups, with 18 of 22 species threatened with extinction according to the IUCN. These ocean wanderers circumnavigate the worlds' oceans and transverse international boundaries, where they come into contact with an array of industrial and artisanal fisheries. The resulting impacts through interactions with fishing gear have been widely documented, an estimated 100,000 albatrosses are killed each year through longline fishing alone. However, a series of mitigation measures exist that can, once incorporated in daily fishing operations, rapidly reduce incidental bycatch of seabirds. BirdLife International has launched the Albatross Task Force (ATF) to work on a global scale with the fishing industry, onboard vessels and in ports, to maximise the rapid uptake and correct use of fishery-specific mitigation measures.

The ATF is active in seven countries, using three languages and dealing with an extensive range of technical, environmental and ecological variables to better understand and mitigate seabird bycatch events. This has presented a complex and demanding requirement for a multipurpose database that would facilitate rapid and user-friendly multi-lingual data input for highly flexible data capture fields plus allow centralised reporting and data exploration.

To manage this requirement, the ATF teamed up with Olrac, a South African company that has developed an electronic data recording and management system for marine-based activities. The software developed by Olrac (Olfish Dynamic Data Logger) is a third-generation, data logging and data management, software tool which was initially developed for the commercial fishing industry, but now provides a complete solution for the collection, management and reporting of other vessel-based activities, such as commercial and recreational fishing trips, oceanographic surveys, marine inspections, cargo and service trips, surveillance missions, observers programs, etc. The present version of Olfish includes three basic components in order to cater for the entire data flow, from at-sea collection to the generation and dissemination of reports on the shore.

The Olfish software was customised to cater for the specific ATF data logging requirements. These customisations included an onboard data recording unit to enable observer laptops to collect data from multiple fishing vessels across a range of fisheries and from a selection of input languages. The ATF version of Olfish allows observers to capture 320 different fields including target and bycatch species, fishing gear configuration, mitigation measure configuration plus wildlife surveys and extensive environmental variables. To date, the ATF has seven units active in South Africa, Namibia and Argentina. In addition the ATF deployed three shore units of the Olfish system as a central hub of data in each country plus a centralised meta-unit capable of integrating data from all countries into a master database. The ATF version also includes a visual data analysis module (Explorer) specifically designed to work with the Olfish main database. This allows the user to analyse and visualise data captured by the Olfish-DDL in tabulated, graphic and spatial formats.

Sea bathing water quality on beaches in the Republic of Croatia - web application

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Republic of Croatia monitors water quality on beaches for many past years. Government of the Republic of Croatia, at its session on 20 June 2008, adopted the “Regulation On Sea Bathing Water Quality”. This Regulation sets out standards for bathing water quality on sea beaches, establishing limit values for microbiological parameters and other characteristics of the sea. For the purpose of attaining the prescribed bathing water quality standards, measures for management of sea bathing water are hereby established. Also the bathing water profile must be determined for the sea beaches. The representative body of the county shall issue a decision establishing the sea beaches on which bathing water quality monitoring shall be performed, and also bathing water quality monitoring activities shall be performed by a legal person authorised for monitoring activities in the field of environmental protection pursuant to the Environmental Protection Act. For the purpose of collecting, validating, managing and public presentation of this data, at the Institute of Oceanography and Fisheries are developed web application.

Data are collected by eight authorised institutions from seven Croatian counties. In the season 2009, 905 locations were monitored. Samples were taken every two weeks, 10 times from mid may until end of september on each location. Results are inserted into web application, and instantly presented on the Internet, on public presentation application part. Data can be inserted manually trough HTML form, or by uploading file (bulk insert). There is two public web addresses, one on Croatian language at http://www.izor.hr/kakvoca and other in English at http://www.izor.hr/bathing. All data on the public presentation pages are organised by counties and cities. There is also available search within city or location name or description. Click on the map showing locations are another way to find desired data. Google maps are used for presentation of locations and each location is colour coded depending of last measured water quality. At the end of the season, locations are colour coded according of final assessment. Also is available reviewing of all past measurement results. Despite of very poor promotion, from beginning of bathing season (mid may) until the end of year 2009, public data was accessed 287460 times (200799 times Croatian and 86661 English version).

Data quality was improved with web application, using semiautomatic procedures, and visualisations that enables authorised persons to instantly correct some errors. Also final assessment of each location is automatically calculated using statistical procedures defined in the local croatian regulation and also according EU directive 2006/7/EZ. The croatian regulation have more strict rules, so final assessment in case of some locations are different regarding used procedures (showing better state in EU directive view then in Croatian regulation view). During bathing season and at the end of the season, web application enables better retrospective of general sea water quality on the beaches. Also statistical parts of various reports about sea bathing water quality are automatically generated by web application. That also includes WISE - Bathing Water Quality Reporting under Directive 2006/7/EC (European Environment Agency).

Bathing water profile is included into web application. Main objectives of bathing water profile are defining beach borders and objects on the beaches on the map. Thought web application users can easily define geographical borders by clicking on the map in the web browser. Also it is possible to upload pictures of beaches as the part of the beach profile.

Web application for sea bathing water quality on beaches in the Republic of Croatia improves beach monitoring in few important ways:

-improve data quality
-easy data input regardless of location of data provider
-shorter time from data analyses to data publication
-presentation of accurate data for general public
-easy reporting

Scientist's desktop tool (SDT) - a system for integrating scientific data from many databases

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Changes and their causes in the marine environment are complicated. In order to get insight into and understanding of the situation many kinds of data types, data sources and many perspectives to data are needed. Thus a scientist needs a tool that can provide intuitive, tempting and efficient methods to access and analyze distributed data.

A system for dynamic data viewing from a marine environmental database was built in former FIMR ('Havaintohaavi'). The new scientist's desktop tool, SDT, is based on the work and user experience with 'Havaintohaavi'. The previous single database, three view case was generalized so that simultaneous use of multiple databases and user defined views is possible with the SDT.

The SDT is an interactive web application (RIA, rich Internet application) that visualizes data from several databases which may have different data structures (database schema) but basically contain same kind of environmental information. The SDT user interface design is based on concepts and use cases, which were presented and suggested by scientists.

The user can define multiple perspectives like time series, vertical profiles and seasonal changes as well as parameter versus parameter charts and these views are dynamically linked together. The user defined views are visible at the same time. The power of this system is that researchers can compare data from different database sources very easily and the origin of the data is explicitly color coded in the charts. Even the meta-data and exact value of each single observation can be probed by pointing it with the cursor.

The three most important features of the user interface are:

- A user can easily define many dynamic views for the user selected parameters
- One view can present data from many different databases
- All the different views interact.

With the SDT data can be acquired from several database systems (e.g. MySQL, MS-SQLServer, Oracle,...) in different organizations. This system has already shown its great added value, when it was used to combine for the first time coastal monitoring database and open sea databases from Finnish Environment Institute and from Finnish Meteorological Institute on the same desktop. The implementation of this integration took only less than one man-month.

The development of the system has shown the importance of the common vocabularies and use of the same coordinate systems and definitions in different but conceptually related databases. The small difficulties that emerged, underline the importance of the large international development projects like SeaDataNet and adoption of the common standards developed together.

The researchers have appreciated the ability of the system to combine data search and dynamic data viewing into one interactive tool. This frees the great potential that lies behind the walls of separate, large datastores.

The software architecture of PyCTOH: an on-line data distribution system for altimetry applications

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The french Centre for Topography of the Oceans and the Hydrosphere, CTOH, applies innovative algorithms for processing altimetric data for oceans, continental hydrology and glaciology applications. Building on over 20 years of experience,a new data distribution system, PyCTOH, provides uniform DAP and web access to along-track and gridded data.

The architecture of the PyCTOH system will be described from the bottom up: storage of datasets, catalogue indexing and access, data retrieval for front-end servers and end-users, and visualisation. Its main developments guidelines are optimising the user experience, system scalability and sustainability.

Because of the new product opportunities available in CTOH, datasets are frequently updated; to avoid full archive reprocessing datasets are split at the lowest interaction level, while keeping common metadata information among them. That is, when treating one altimetric data track, instead of keeping the dataset as a full set of parameters (ku range, ionospheric correction, ...), they are split in different files, while using a relational database for indexing and metadata tagging each subset. When a new parameter is added to the same dataset, we do not need to fully recreate each dataset file, but simply add it to the dataset and update the catalogue and metadata indexes.

Catalogue indexing and access is performed using an industrial-strength relational database system: PostgreSQL.
It provides very effective management of the over 50 million records we currently handle spanning about 10 terabytes of data.
Data storage has also to be scalable to that extent. A standard storage web-farm provides data splitting over several storage servers, and throughput aggregation thanks to a squid-based cache hierarchy.

Data access is provided by two channels: a custom in-house DAP-based server and a standard web interface.
The former provides live access to our data using the Data Access Protocol over HTTP, being compatible which clients such as Matlab®, IDL®, and Ferret. The latter, based on the Plone Content Management System, provides a graphic interface to data extraction and pre-visualisation , while being itself a DAP-client for the database DAP server.

Data validation:The MONICAN experience

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Summary
Instituto Hidrográfico (IHPT) has started a project to monitore the marine environment in near real time, expanding the existing networks of coastal observation for tides, waves and meteorology adding offshore and inshore multi-parametric buoys. The fact that data dissemination is in near real time implied a modification of the validation processes.
The different steps for the quality control implemented and the conclusion related to the meteorological data are shown.

1. Introduction

The Nazaré Canyon is an area covered by several international projects studying the sedimentary and dynamic processes from as early as 1993. In most the Instituto Hidrográfico is a partner: OMEX (1993-1999); EUROSTRATAFORM (2002-2005); HERMES (2005-2009); HERMIONE (2009-…)
IHPT manages the Portuguese network of tides gauges. IHPT maintains a network of meteorological stations, since 1980, located along the continental littoral.
This ensemble of historical data and availability of resources well established allowed for the comparison of different sources as a means of validation.

2. The project MONICAN

MONICAN is the acronym for Monitoring the Nazaré Canyon. The aim of this project is to do the monitoring of the W area of Portugal, where one of the largest submarine canyons of the World is located, and make the data available through the World Wide Web.
The observing system comprises the placement of two multi-parametric buoys, one at an offshore position, already deployed, and another near shore to be deployed during 2010. This set is complemented with: two tides gauges, one at Peniche, the other at Nazaré and a meteorological station at Ferrel, with a data history of twenty five years.
This assembly of stations and their communication capabilities will allow for the fulfillment of the objective: the monitoring of the marine environment on the Nazaré region in near real time (figure 1).
In April 2009, the first multi-parametric buoy was launched near the 2000 m isobath. This buoy contains a directional gauge with surface, subsurface and meteorological sensors. Surface sensors comprises a directional wavescan, sea temperature, oxygen, chlorophyll-a and oil spill presence. At subsurface: four thermistors at 10, 50, 100 and 200m and an acoustic doppler current profiler pointing downward at around 7m. The set of meteorological sensors is quite standard: air temperature, relative humidity, atmospheric pressure, wind direction and speed.

3. Data Generation, Flux and Quality control

IHPT receives, every hour, an e-mail from the offshore buoy, via Inmarsat-C satellite. The encrypted e-mail is converted to an ascii record which contains wave data – height, direction and period; all the sea temperatures; environmental data - oxygen, cl-a and oil spill (y/n); and meteorological data - air temperature, atmospheric pressure, relative humidity, wind speed, direction and gust. These and the others parameters not sent - spectral wave parameters, currents data, are archived using the internal storage capacity and are downloaded afterwards. The others stations, included in the project, as meteorological and tide gauges communicate remotely with IHPT, via GSM.
All the data received is stored at databases, designed using Oracle software, from where the data is distributed through the web portal. (figure 2)
Data generated at the buoy undergoes a first quality control step during storage. Embedded software applies a validation window to the data based on the characteristics of each sensor. Similar

procedures are applied upon reception of the data at IHPT, for meteorological data or, at the land station, as is the case for the tide gauges.
To build a working method and following the example of what is done by the team of Puertos del Estado (Spain), two other steps of quality control were created: the validation within acceptable values for each parameter and the checking for differences between consecutive items.
To complement these steps, for sea temperature another cross checking was done - the comparison between monthly values and the climatology. Table 1 shows the case of July.
At this stage, all the data is complemented with flags, to acknowledge the end-users of its quality.

4. Meteorological data quality control
Having different stations in the project with the same kind of parameters, gave us the possibility of studying inter-comparison as a validation tool. Monthly, a visual analysis of the time series is made, for the same parameters. This allows another quality control of the data and suspicious values are identified. As an illustration, we show the plot of air pressure measured at the offshore buoy and at Ferrel meteorological station (figure 3).

5. Some products
In the web portal, at the Products' separator, graphics generated for each month are included, like the ones for meteorological parameters, those with the inter-comparison of temperatures from the surface till 200m depth, as well as the similar results between the data produced by the SWAN model (Simulating WAves Nearshore) and the one collected by the multi-parameter MONICAN buoy.
(figure 4)

6. Conclusions
Comparison between the atmospheric pressure from the buoy and Ferrel station reveals a systematic 2 hPa difference, as shown in figure 3.
The variability of the pressure from the two stations, was the same in all frequency domains (figure 5), what leads to the conclusion that a calibration of one of the barometer sensors may be needed.

7. Acknowledgement
We thank the team from Puertos del Estado for the collaboration regarding the managing and quality control of buoy data which allowed us to better our own efforts and walk towards a common working method.

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Determination and web presentation of water types in Croatian part of the Adriatic Sea

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As EU candidate Croatia is in the process to define marine water body's characteristics and their spatial distribution according EU recommendations. Institute of oceanography and fisheries from Split in collaboration with Centre for marine research from Rovinj and Croatian waters from Zagreb defined: transitional and coastal waters, water type characteristics and water type bodies.

Transitional waters are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows.

Coastal water means surface water on the landward side of line, every point of which is at distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breath of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters.

As in EU countries there are a quite big differences in properties of transitional and coastal waters, EU Guidance No. 5 specifies possibility of implementation two types of classification of water body categories (A and B) depending of specific morphology and water dynamics in specific country. Taking in account physical, chemical and biological characteristics of transitional and coastal waters in the Croatian part of the Adriatic Sea watershed area and their spatially and timely variations B system was chosen, which define geographic position, depth, mean annual salinity and tidal range as compulsory indicators. Beside this, more additional indicators specific for Adriatic Sea was chosen as: and supstratum composition, mean annual temperature and salinity, wind exposure, currents, nutrients, biologic characteristics, traffic routes, beaches, protected areas, fish farming sites, etc.

As task was a quite complex because usage data of more different parameters, which are randomly distributed in space and often undersampled, special attention was paid on data harmonisation and integration. Data was uploaded from more Croatian databases as Marine environmental database of the Adriatic Sea (MEDAS), HR-Natura-2000 and AZO-Land Cover. GIS tool (ArcView 3.3.) was used for construction of spatial fields of all indicators.

Output results (.shp files) obtained by GIS were converted in Keyhole Markup Language (KML) and presented by Google Earth through IOF web server (www.izor.hr/tipovi-voda).

Based on analyzed indicators 7 types of transitional waters with totally 28 different waters bodies in wide area of mouths of 10 rivers, and 5 different water types with totally 22 water bodies in coastal waters was recognized.

Determination and presentation of water types via web represents important role in research, monitoring, and management of Croatian coastal regions.

A relational database for high resolution multibeam bathymetry sets

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A relational database has been implemented to allow user-defined searches via various queries, like: project name, system used, date of acquisition, geographic location, e.t.c for both ping multibeam records and gridded bathymetry data. There are two categories of data and metadata that are included in the database: the original observations or measurements (the raw or ping-edited swath files) and the derivations from these observations or products assembled from many different raw files (swath bathymetry maps, slope maps, digital elevation models, sun shaded relief images, 3d views, e.t.c). Derived products also include cruise reports, scientific papers, presentations, educational products, bibliographies, etc.

Our first aim was the creation of the metadata information table. This table consist of 23 fields, as for example: area_of_survey, project, vessel, system, data_filename, year, month,day, time_start, time_end, lon_min,lon_max, lat_min, lat_max, trackline_length, depth_min, depth_max, e.t.c. Most of this information is extracted directly from the original multibeam files via the mbinfo program of the open source software package MB-system (www.ldeo.columbia.edu/res/pi/MB-System). All this information is stored in an MySQL relational database management system, which help us to develop the structured query language database schemas, design tables, create forms and tools for the input of data, populate the tables, and implement graphical applications for browsing, query and visualization.

The second focus of our efforts has been the development of a Web-Map interface which is using a Java TM applet intended to give easy and versatile access to geographic data sets through a web browser. At its very simplest, this means a keyword or graphical map-based query that can lead directly to a trackline map, a gridded bathymetry map, 3-d views or a URL (when the metadata are not in a published form that we can directly query).

We expect that this high resolution bathymetry database will not only provide greater use of existing data and at some level a communication tool for activities associated with the HCMR's initiatives, but also will serve public outreach by providing knowledge and information for a broad spectrum of education and research activities. Also, the associated Web-Map interface makes it even easier for the non-specialist to visualize data and appreciate its intellectual value.

Data center from scratch - Integrated Ocean Data and Information Management System (ZSPDO)

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Oceanographic data originated from worldwide experiments have growing importance and influence decisions processes and policymakers. Accessibility to information for decision makers is crucial for leading such processes. All organizations involved in oceanographic research and data providers are responsible for maintaining infrastructure for data storing, processing and running data providing services. Institute of Oceanology, PAS (IOPAN) maintains huge archives of information gathered during research activities performed for more than 50 years. These data, originating from different sources are being processed according to common practice elaborated through generations of oceanographers, however there appears to be a very strong demand for standardization of procedures, especially while facing problems regarding cooperation in data exchange. To enable cooperation in data exchange on higher level IOPAN has decided to develop data center and deploy system for management of data and information, using well defined and widely used standards of data processing defined within SeaDataNet project.

Regardless of the everyday practice of data processing (however adopting its positive features) IOPAN developed project Integrated Ocean Data and Information Management System (ZSPDO). The project has defined following goals: -to build ocean data repository with data management and processing system ensuring data availability, increasing data accessibilty providing catalogue services and reducing risk of data degradation and data loss; – to deploy management system for research and development projects and works performed by Institute according to standards and identified processes; - to deploy management system for resources used and people engaged in research and administrative processes optimizing human work, accessibility and utilization of the resources; - to develop eLearning platform and data visualisation services providing tools for teachers and trainers at different levels of education; to deliver platform for data and information delivery services; to build organizational and technological infrastructure (ensuring development, management and coordination of national and international projects from the marine research domain; data, information and metainformation provisioning to: marine research institutes and coastal, environment and marine management organizations; industrial R&D organizations active in shelf, coastal land and river estuaries areas involved in exploitation of marine environment; national and international scientific institutions; administration and authorities at local, regional and national level; others interested in) and to increase possibility of hosting data and services at high quality level.

New approach to training and teaching activities is possible using advanced technologies and eLearning platform. Multimedia materials published for educational purposes are easily accessible through the electronic communication channels for dissemination of information as well. Development of tools enabling both of processes is one of the objectives of ZSPDO.

The project is in an early stage of execution. Expected results of the project are as follows: - ensurance of security of agregated information resources; - improvement of data exchange with international organisations ; - automatization of metainforamation discovery and publication; - normalization of data and information exchange procedures deployment in widely used standards (eg. SeaDataNet); - improvement of research project management with developed tools for budget and resources administration; - monitoring of the administration processes and quality management within projects; - improvement of efficiency of research works providing fast and easy access to data repository.

The project is scheduled to be completed at the end of March, 2012.

A relational spatial oceanographic database interfaced web for the moroccan Atlantic coast

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A dynamical and relational spatial geodatabase was constructed at the Department of Oceanography and Aquaculture of the Institut National de Recherche Halieutique (INRH), in order to facilitate the access in intranet for the local researchers to the spatial (remote sensing) information of the behavior of the oceanographic parameters along the moroccan Atlantic coast. This work is requested to answer of a need of the quantification and the description of the upwelling phenomenon which occurs seasonally or all the year in this area. The data was managed and reorganized via web dynamic pages also via HTML, PHP , Java Script and SQL languages. The requested results is to obtain a quick and view in delay mode of variability of the upwelling both spatial and temporal, also with a rapid access of the data in different formats (ascii, byte and png, jpeg or tiff) with the automatic display of the plots.

Key words: Oceanographic database, Atlantic coast, Morocco, interfaced web, remote sensing data.

Rescuing historical marine data and making them accessible: the case of data collected during the first years of modern oceanography in Belgium

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Large databases are needed for oceanographic and climate research. Particularly, historical ocean data are required to study global change and to define a “reference status” in the context of international agreements and directives. Access to these data is thus a crucial issue for the scientific community.

Belgium has a long oceanographic data collection history. However, a lot of these data are still only available on media that are not suitable for electronic data processing. Recently, the Belgian Marine Data Centre launched, with the financial support of the Belgian Science Policy, a 2–year project aiming at identifying the Belgian historical marine data recorded on media at risk (“Data Archaeology”) and to “rescue” as many of these data as possible (“Data Rescue”). That work will contribute to safeguard and make available an old dataset particularly important for any marine or climate research where evolution over time is under consideration.

The targeted information is the data collected during two multi–disciplinary scientific programmes, namely the “Project Sea” (1970-1976) and the “Concerted Research Actions” (1977-1982). These datasets give a broad overview of the Belgian marine waters and of the Scheldt estuary status during the 1970-1982 period. Almost all datatypes are present: physical and chemical characteristics of water, sediment and air, biota quality, characterization of sediments, biodiversity and physiology data (kinetics).

These data are kept in the following forms and formats: (1) paper reports (written text, tables and graphs), (2) raw backups of punched cards and magnetic tapes and (3) archives of the researchers. As no standard methodology exists to rescue data, ad–hoc procedures are being designed. They follow these guidelines:

- locate the data at risk of being lost,
- track and rebuild the corresponding meta–information,
- digitize and check the data,
- import the data in IDOD, the multi–purpose database developed by the BMDC, together with the meta–information and the applied rescuing methods,
- publish the dataset.

A follow–up committee, made up of Belgian and international experts in numerous fields (data rescue, physical oceanography, contaminants, diversity and physiology of living organisms), will validate the process.

Finally, two case studies demonstrating the importance and the usefulness of this “new” dataset will be performed.

The present communication will give an overview of the material and the methods to be used during the project and will describe the problems we met during the first months of the project.

Electronic Posters

Salinity and temperature climatologies of the North Sea using the Variational Inverse Method

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SeaDataNet (www.sedatanet.org), a pan–European network connecting the existing professional marine data centres of 35 countries, is currently setting up a distributed data management infrastructure. Beside this information network, the consortium is also developing various management, visualization and analysis tools.

In order to demonstrate the usefulness of the architecture and of the tools for elaborating meaningful products, several partners are currently producing climatologies for the European regional seas, the Antlantic and the global ocean. To compute these reference fields data from many sources are analyzed by means of the Variational Inverse Method (Brasseur et al.,Deep-Sea Research I, 43:159-192, 1996). This tool, also known as “DIVA”, is one of the standard common tools significantly improved in the frame of SeaDataNet.

The poster shows the progresses made so far in establishing consistent salinity and temperature climatologies for the North Sea over the period 1975-2005. Compared to other products, our analysis provides better resolution of basin-scale processes. Physical constraints such as advection and boundaries are incorporated in the interpolation process, making the resulting fields more relevant. Error fields are also computed, allowing to estimate the level of confidence of the results and to identify area with insufficient or inconsistent data.

Compared to earlier results, these S,T-climatologies now include the optimization of the signal–to–noise ratio and of the characteristic length.

Digitizing and archiving former marine data from paper media

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As is well known data digitizing from paper media represents certain difficulties particularly in the case of large-format sheets or tapes. Such materials were commonly used to fix information in oceanology and submarine geology before expansion of computer technology.

Institute of Geological Sciences, NAS of Ukraine, have a mass of information on paper media containing rezults of former marine investigations. There are many thematic maps, cruise reports, sonar records, tables of several analytical data, scientific papers and books. To provide easy access to that resources for participants of the BSS network and all other persons concerned it is expedient action to digitize such data and efficiently compress files for sending via Internet. With that end in view it was carried out comparison and expert evaluation of popular devices and software suitable for this task. Technical characteristics of flatbed digitizers and scanners were compared with potentials of digital photographic cameras, merits and demerits were revealed. Also it was examined device productivity. With regard to cost benefit analysis application of a digital camera with the sensor 10 – 15 megapixel was found the best. Additional implements have been designed to facilitate photography and now the digitizing is making actively.

Several graphic processors were compared with special cartographic software such as ERDAS Geospatial Imaging 9.3 and ER Mapper 7.2 to determine their capacities for correction of distortion and artifacts, unavoidable in photography. It was ascertained the next: for making presentations, illustrative and educational images quite enough any popular graphic processor, the best of them is the last version Adobe PhotoShop, but for scientific investigation Geospatial Imaging 9.3 and ER Mapper 7.2 are more suitable, because of they contain a great number of modules for correcting images, linking fragments (mosaic), associating to geographic coordinates, also to operate with cartographic projections.

Text and tabular information after transformation in digital images usually are processed with OCR software. We use now ABBYY FineReader 10 since it can convert tables without destructions and allow to save them in MS Excel format, that is convenience for import into databases. Large text documents saved in plain text format such as *.txt or *.fb2 used for e-book.

As regards big files. Text and tabular files are well compressing by any popular archiver. But for big graphic files more suitable is such as DjView archiver, and for archiving very big files (1 GB and more) the special module of ERDAS software may be recommended because of it is capable to reduce the size of a big graphic file up to 2 – 3 orders.

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Towards to marine informatics network; a case study from Turkish Black Sea Coast within upgrade BLACK SEA SCENE Project

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By setting up a new information system (Upgrade Black Sea Scene Network), upgraded version of existing one aims to inventory and manage knowledge and related informational resources acquired during its previous, ongoing or coming projects. Upgrade BSS Network aims to summarize acquired knowledge by using standardized formats which facilitate knowledge and related informational resources (metadata and data formats) sharing. This study presents our online directories of marine datasets (EDMED), marine research projects (EDMERP), sea-going cruise summary reports (CSR) and Common Data Index (CDI) database with input and regular updating of ourselves. Our contribution presents a standardised data set for Turkish Black Sea coast and consequently preparing the regional data providing full and transparent data access by internet, quality control and storage to online dissemination and distribution and adopting overall quality control procedures.

Current system of environmental monitoring data collection, processing and holding at the Danube Hydrometeorological Observatory

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Danube Hydrometeorological Observatory of State Committee for Hydrometeorology of Ukrainian Ministry of Emergency Affairs (Izmail, Ukraine) is an organization which monitors conditions of water objects at the Ukrainian part of Danube delta and neighbouring part of the Black Sea. This work is carried out as a part of national monitoring program.

At the moment stationary network of the hydrometeorological observations at the Ukrainian part of the Danube mouth area consist of 9 river hydrological stations, 2 marine stations and 5 stations on lakes located at the Danube region. Monitoring program includes water levels and temperature measurements, waves and ice observations, turbidity probes. Also it includes observation of meteorological elements like air temperature, amount of precipitation and wind characteristics. Marine stations also conduct water salinity monitoring.

In addition Danube Hydrometeorological Observatory carries out regular field work at the Danube delta. This field work is focused on water flow and stream load research, on morphological processes, dynamics of the delta sea side and processes of sea water ingress at the Danube delta.

Marine monitoring program was developed to research regional and seasonal changes in elements of hydrometeorological regime at the Black Sea water area neighbouring Danube delta. It includes cruise water temperature and salinity measurements, current research and waves measurements. Control of the meteorological parameters is conducted on 56 roadstead stations, on 9 stations of the long-term profile Bystryi branch – Black Sea and on 3 multiserial stations.

Another large part of work conducted by Danube Hydrometeorological Observatory is a regular observation of environment pollution at the Danube delta and neighbouring Black Sea area. Observation program includes daily measurements of air pollution and radiation level and monthly water samples collection and analysis. Water samples are collected on 16 river and marine stations. Sample analysis is based on 37 quality factors and includes detection of biogenes, oil pollution, phenol, heavy metals etc.

Environmental monitoring program is conducted by Danube Hydrometeorological Observatory for more than 50 years and as a result a huge amount of data was received. The most part of raw and systematized data are stored on paper. From the mid-ninetieth The State Hydrometeorological Service of Ukraine started development and implementation of the software products for the input of hydrometeorological data into databases, statistical data processing and data quality control. First programs of that type was:

“Automated information system – Hydrochemistry” – software for water quality monitoring data input into the State Water Cadastre via DBF files.

“Automated information system – Meteo” – software for processing and systematization of the air pollution data.

“Cadastre” – software for data input of the results of hydrological monitoring of lakes at the Danube region into the databases and for data quality control.

All this programs were developed by enthusiasts from different subunits of hydrometeorological service and as a result data formats, templates and databases structures are unique for every product.

Next step in automation of data collection and processing for hydrological, meteorological and hydrochemical monitoring was implementation of ASSOKA software package (Automated system for collecting, processing, analysis and quality control of monitoring data). This software was developed at the “Hydrometeorological bureau of Sevastopol”. Now this software package includes three modules: ASSOKA – Hydrochemistry, ASSOKA – Marine Hydrology, ASSOKA – River Hydrology. This software allows data input of regular observations, conducts data quality control according to different attributes

in automated mode. Also it makes possible statistic data processing and generation of resulting tables in national database standard.

As can be seen from the above methods of data collecting, processing, analysing and data quality control used in the Ukrainian national environmental monitoring system are rather actual. However not only data and databases, even information about their existence is not available for organizations and educational institutions on national and international levels. Positive shift in situation with access to the environmental monitoring data was made possible due to participation of Danube Hydrometeorological Observatory in Upgrade-Black Sea SCENE project.

The UP-GRADE BS-SCENE project is an FP7 EU funded project running from 2009-2011 that is building and extending the existing research infrastructure (developed under FP6 project BlackSeaScene 1) with an additional 19 marine environmental institutes/organizations from the 6 Black Sea countries.

Implementing FP6 RI SeaDataNet project standards regarding common communication standards and adapted technologies will ensure the datacenters interoperability. Main output will be on-line access to in-situ and remote sensing data, meta-data and products.

Within the framework of project Danube Hydrometeorological Observatory will enter the SeaDataNet structure through national data center (NODC) which was founded on the base of Marine Hydrophysical Institute. Currently the metadata catalogue of the Danube Hydrometeorological Observatory was created with MIKADO tool in SeaDataNet format and placed into EDMED vocabularies.

Before the end of the project in 2011 the following steps to integrate Danube Hydrometeorological Observatory databases into the SeaDataNet structure will be made:

Current data quality system appraisal and adaptation to international protocols.

Creation and integration of CSR (Cruise Summary Reports) records into the SDN.

Providing access to data via CDI service.

Data Management for IPY in the Netherlands

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In the Netherlands 17 scientific projects took place within the IPY context, in a wide variety of sciences ranging from oceanography to social sciences. In its function of national polar data centre for the Netherlands, NIOZ is responsible for managing the IPY data. Data management activities only started in full force in 2009 so after most of the IPY projects, or at least the data collecting phases, were concluded.

This poster is about some experiences from and thoughts upon the process.

Cooperation of the scientists is essential firstly for their knowledge of the scientific context and the data, obviously, and secondly for their informed opinions on the re-use of data from which requirements for the publishing of data can be derived. Data from different sciences differ in structure – think of a series of concentrations of a trace element in ocean water compared to a description in measurements, text and drawings of a historical site – and in the metadata required for the correct interpretation of a single measured value – e.g. a count of organisms in a soil sample for which the climate conditions were artificially modified.

Data Management focuses on three main points:

1. archiving the data
2. registrating data
3. publishing data

Ad 1. Archiving data

Data need to be stored on a safe filesystem with proper procedures for back up etc. in place and with a reasonably secure long life expectation. Preferably data in their most original form.

Ad 2. registrating data

This is done by adding dataset descriptions to the Global Change Master Directory (GCMD). Purpose is to make the existence of the datasets known and to create one single collection where all IPY dataset descriptions can be found. The GCMD tools ensure use of the IPY metadata standard (DIF); exchange of dataset descriptions with other data portals is possible through the standard protocol OAI-MHP.

Ad 3. publishing data

Cf. the IPY data policy all IPY data is to be made available “fully, freely, openly, and on the shortest feasible timescale”. We aim to store the data in only one repository and to minimize fragmentation: rather add to an existing system than build yet another new one. Still, suitable repositories (like SeaDataNet for oceanographic data) will not be available for every collection of data. Some will require tailor made solutions. A data portal for the National Polar Data Center is to be designed and built. The data will be available in standard formats such as Ascii, Excel, NetCDF.

Organization of data and information access via local network and via Internet in Marine Hydrophysical Institute

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The MHI Bank of oceanographic data (BOD) contains temperature and salinity, hydrochemical, meteorological, drifter, current, optical data and climate information.
Two types of data access were organized in MHI: access via the MHI network and on-line access.
The access to BOD via the MHI network is realized as client application. The last version of the software allows selecting hydrological and hydrochemical data, currents, drifter and sea level data. The selection can also be accomplished on time and space, as well as on values of the considered parameters or quality flags. Data can also be selected by research vessel, cruise, drifter and hydrometeorological station. The software provides data visualization, processing and export to several standard formats including MEDAR/MEDATLAS II and ODV formats.

At present time on-line access is organized for the following information:

- temperature and salinity data,
- operational oceanography information,
- satellite information,
- Black Sea Atlas

On-line access to the temperature and salinity data allows to work with the map, to make visual selection for time intervals, organizations and cruises, to export selected data to ODV format. (http://ocean.nodc.org.ua/DataAccess.php).

The access to the operational oceanography data gives an opportunity to view the meteorological and physical parameters measured at the Experimental Branch of Marine Hydrophysical Institute (EB of MHI) situated on the Southern coast of the Crimea and the Danube data on water flux and level.
The software for access to information from EB of MHI enables to view graphics for selecting a parameter (level, temperature, atmosphere pressure, wind, water pressure) and a time interval. (http://www.ocean.nodc.org.ua/Katsively.php).The Danube data cover the period from December 1, 2008 till June 1, 2009. To view a diagram a user should select a parameter and a time interval (http://www.ocean.nodc.org.ua/Danube.php).

The satellite data access allows viewing images of the following parameters (http://www.ocean.nodc.org.ua/satellite/):

- SST (Sea surface temperature),
- CHL (Chlorine concentration);
- WLR (Water leaving radiation);

The satellite images are received every day. To view the image it is necessary to select one of the parameters mentioned above and date.

The map viewer of the Black Sea Atlas (http://www.ocean.nodc.org.ua/BS_atlas/) provides map selection by section, temporal parameters, depth, etc.

Atlas consists of 7 sections:

1. Oxygen lower and H2S upper boundaries;

2. Hydrology. This section consists of 7 subsections: water temperature, salinity, density, sound velocity, geostrophic currents, heat storage and SOFAR channel.

3. Secchi disk depth;

4. Hydrochemistry. It includes 6 subsections: oxygen, hydrogen sulphide, silicon, nitrate, phosphate and ammonia.

5. Hydrobiology.

6. Geology;

7. Climatic conditions.

Increase of efficiency of use distributed ESIMO data

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The Unified National System of Information on the State of the World Ocean of Russia (ESIMO, http://data.oceaninfo.ru//) is an interdepartmental distributed system of the information on the World ocean.
ESIMO integration technology is intended for formation of a uniform information field on ESIMO subject domain using distributed information resources system (SRBD) ESIMO. Integration technology includes following basic components on the program level: Data Provider (DP) and Integration Server (IS).
Program complexes DP and IS are applied as the basic tools of exchange and delivery of data between segments of distributed system data sources. DP is for connection with external data sources (DB, file systems) by means of local data transformation into unified protocol and data exchange formats. IS can be applied for assimilation of data by means of distributed data sources network management, referencing to data sources, obtaining of exchange transport file and information exchanging with remote users automated workplace.
During the last years the number of ESIMO information component has increased. So direct use of IS by automated workplaces and information service systems is inconvenient for some reasons.
First, usually the automated workplace consists of a number of program components. A few instances of one component can join into automated workplace. Each of which works with the same or similar set of data and metadata. Repeated queries of the same data and metadata by different components and their instances additionally load IS and network channels.
Frequently, the data received from SRBD requires some preprocessing. It can be associated with internal format of program component which uses the data of an information resource. Also it is possible that the information containing in information resource (IR) is incomplete by set of attributes or by spatial or temporal coverage and integration with others IRs or accumulation of several data portion of one IR required.
Such preprocessing does not concern a direct functional purpose of a program component and, first, complicates logic of component program application and secondly increases time of data processing by a component and as consequence the total loading on automated workplace node. In the same time IS is engaged in distributed data sources network management and should not process independently the data on each problem which solves an automated workplace.
At the moment in some automated workplace and information service systems of the ESIMO the caching technology the data and the metadata, a named Internal Database (VBD) is applied. VBD assumes loading on delivery and a preprocessing of the data and plays a role of the bridge between SRBD IR and an automated workplace component. It is accountable for currency, integrity and completeness of the data and the metadata transferred to automated workplace. VBD program complex is deployed on the automated workplace node side, serves an automated workplace or group of automated workplaces only for one ESIMO centre and therefore does not add additional loading on IS.
VBD contains a number of the important technological features. IR data processing constructs by a conveyor principle. All process breaks into a number of consecutive stages or VBD IR life cycle stages. IR life cycle builds dynamically. IR structure may vary eventually (new elements adds, its type, accuracy varies). Structures of the data in VBD are self-described. Its description is updated dynamically at updating of IR description at IS. For this purpose VBD referencing to IS web services. Also audit of IR structure changes history is conducted. It allows to notify program components of an automated workplace that there was a new version of some IR and to specify what changes have occurred with it.
Functional of the VBD grows. But already now it is possible to draw conclusions that caching technologies using (on VBD example) allows to accelerate considerably access of components of the distributed system to the data and the metadata and also to simplify process of IR integration.

Recent development of the data base for the Ferry-Box data collected by IMWM

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The measuring system Ferry-Box has been deployed in frame of the HELCOM Baltic Sea Regional Project (BSRP) and financed from the resources of the World Bank in 2007. An autonomous “BlueBox” module installed on a commercial passenger ferry between Gdynia (Poland) and Karlskrona (Sweden) constitutes the main element of the system. Among others, this module provides online measurements of temperature, salinity, oxygen and chlorophyll-a fluorescence and data collection during all the cruises. After two years of the system exploitation it became obvious that efficient use of the autonomous Ferry-Box system data requires suitable tool for data storage and its maintenance. Despite the value of the data for any research and monitoring purposes, due to the nature of the measurements from the board of moving ferry the data is varying in space and time. The variations are caused by some changes of the cruise track of the ferry as well as various crossing time of the sea during a year. While an analysis of the single data set (one cruise) is relatively easy, the presentation of the raw data on the web page and use of many data values for any statistical analyses creates some difficulties related to the data selection from the thousands of records of the original sequential data base.

Some results of the data variability analysis in relation to the space and time are presented. These results have created the basis for the data base design, its development and implementation.

A data base software system in a form of an executable application was designed and installed at the Oceanographic Department of IMGW Maritime Branch. While the data base application works as an executable application, all the data are stored in a SQL data base format. The main purpose of the application is collection, storage and dissemination of the Ferry-Box data. It was designed to contain unprocessed values as measured by all sensors, i.e.: temperature, salinity, oxygen concentration, fluorescence and turbidity. During the process of the data import to the data base some important meta data for further data manipulation are added to the records. One of the key features of the application is possibility of data selection, aggregation as well as removal of outliers and he series of doubtful values.

The application has passed first tests of its functionality when exported aggregated data was used for graphical presentation in the same manner as for planned internet visualisation.

Implementation of DIVA 4D Version in the Mediterranean Sea

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DIVA is an interpolation and variational analysis software tool, developed by the University of Liege that is being used within the FP6/EU/I3 SeaDataNet Project for the preparation of the regional climatological products. Diva performs horizontal analysis on a finite element grid allowing for a spatial variable resolution and takes into account coastlines and bathymetry features. The parameters of the analysis are optimized using the Generalized Cross Validation method. Error maps for the gridded fields can be calculated allowing the assessment of the reliability of the computations. The latest 4 dimensional version is a set of scripts that automate the analysis in the vertical and in time. Some of the new version features are: faster and more robust mesh generation, adequate contour generation from a topography mask, option to use relative correlation length spatially changing depending on data coverage, option to calculate a lower limit for correlation length, option to eliminate data that are not on the mesh before analysis parameter estimation, option to create a data set from which outliers are eliminated, detrending, possibility to create a pseudo-velocity field so as to increase correlations along topography, semi-normed reference field.

The pre-requirements for the automated version are the preparation of the input data in ODV4-Seadatanet spreadsheet format and the control execution files. The DIVA 4D Version has been remotely installed in the Hellenic Data Centre in a Linux machine and this works presents the results of the computations in the Mediterranean Sea and its basins. Furthermore, long term variability of temperature and salinity DIVA is an interpolation and variational analysis software tool, developed by the University of Liege that is being used within the FP6/EU/I3 SeaDataNet Project for the preparation of the regional climatological products. Diva performs horizontal analysis on a finite element grid allowing for a spatial variable resolution and takes into account coastlines and bathymetry features. The parameters of the analysis are optimized using the Generalized Cross Validation method. Error maps for the gridded fields can be calculated allowing the assessment of the reliability of the computations.

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Development of operational sea level monitoring and forecast system on Estonian coast, the Baltic Sea

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Since 2005 Marine Systems Institute, Tallinn University of Technology develops operational sea level information system. System incorporates measured sea level by autonomous measuring stations, permanent and temporary ones, up to 12 along the Estonian coast and sea level forecast by HIROMB (High Resolution Operational Model of the Baltic Sea). Autonomous stations transmit data every 5 minutes and the data are in real time assimilated into forecast system which delivers sea level forecasts automatically every 6 hours. Open access website built for the sea level information system displays measured sea level in real time with data history and 48h forecast.

Among the users of the system are governmental organizations dealing with rescue issues, also Maritime administration, ferry companies, municipalities and other bodies and citizens. Statistics of the pagewievs of the system (~650kPW at year 2008) shows that interest to operational sea level data and forecasts is very high. Looking at daily pagewievs then these crow significantly, 100 and even 1000 times, in case of storm surges, when flooding can occur on the certain locations along the coast. The public interest is also very high when low water level is forecasted as it influences on a regular ferry connections with islands.

All on-line sea levels stations are connected geodetic height system, so all measurements and forecasts are broadcasted as absolute heights, easy to interpret both in marine and coastal applications. Some stations (6 at present) also serve as source data for renovation of Estonian state geodetic height system allowing use the data to transfer heights from mainland to the island. This exercise of course put special requirements to measurement instrumentation, also to the leveling at the stations, which is done more frequently. Data quality in the systems is continuously traced, both by automatic and manual procedures. Generally systems has worked well percentage of missing and faulty data is less than 3%. Preciseness of sea level forecast lays inside +-10cm in 95% of cases.

Development of operational sea level monitoring and forecast systems contininues, some more stations will be installed, as well data handling and assimilation into model will be updated in coming years.

Building a harmonized in situ Data Management System for the Mediterranean Sea

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Operational oceanography nowadays plays a critical and significant role supporting the policy making and environmental management. The in-situ data are a substantial part of this process and seems to be the most challenging in terms of data collection, management, quality assurance and access. On the other hand, this upgraded role of the operational oceanography contribution should be followed by the provision of high reliability products that are provided in standard common ways. Several steps have been made the last decade in European scale during a number of EU funded projects (MFS, MERSEA, SEPRISE, ECOOP), and other initiatives towards the integration of the in-situ datasets which are produced and disseminated by several data centres internationally. In MyOcean project the effort to integrate the data streams in Europe from the global to the regional scales is intensified in order to assemble high quality data sets, provide the “best” in-situ products for data assimilation and define quality control procedures and validation processes.

As far as the Mediterranean region is concerned, the experience and practice of previous years has shown that a qualitative upgrade of the data flow has to begin from the regional level. The effort has to be focused in building a structure capable to harmonize different data steams and resolving inconsistencies regarding data management policies between research centres. The HCMR’s operational oceanography department coordinates the joined efforts of the major Mediterranean data centres (ENEA, OGS, IFREMER, PdE) towards the above aims inside MyOcean project. Following the heritage of MFSTEP and MERSEA projects, the Med team works with one thematic centre for each group of data (VOS, Buoys, Argo, Gliders) while HCMR builds a Central Regional Portal, where the data from the different regions of the Mediterranean will be collected in daily basis. The presented data production lines are designed by each partner in order to serve the idea of a homogenous way upon data management. Thus a common binary file data format has been adopted (Oceanside’s NetCDF V1.1) together with the pre-existing ASCII format (Medatlas), while common quality control procedures will be implemented. Such a development requires a close collaboration with SeaDataNet in order to get feedback for data and metadata archiving methods, catalogues to be used for easy data discovery, enhanced regional climatologies and services for coastal data that are out of the scope of the MCS/GMES. Furthermore an upgraded collaboration with the other MOON & MedGOOS partners is important as they are the institutes that collect the observations in the Mediterranean Sea. This experience will contribute to the planning and integration of the operational ocean observing and forecasting system in the Mediterranean and following the MOON’s strategy will promote the development and optimization of the scientific base, the technology and the information system for operational oceanography. Finally these practices can be inherited by MedGOOS in order to promote the implementation of a regional framework for partnerships, synergies and capacity building for operational oceanography to the benefit of all coastal states in the region.

NODC-i - National Infrastructure for Access to Oceanographic and Marine Data and Information in The Netherlands

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This poster will present the Dutch NODC-i project, the national infrastructure for access to oceanographic and marine data and information in The Netherlands. The NODC-i project is run by the National Oceanographic Data Committee (NL-NODC) of The Netherlands. The NL-NODC is the national representative in the EU-SeaDataNet project. The NODC-i project is a technical project which resulted in the Dutch node in the SeaDataNet infrastructure. The goals of the NODC-i project are therefore very similar to the goals of the EU-SeaDataNet project, albeit aimed at a national level interconnecting the data centres of the following Dutch institutes: RWS, KNMI, NIOZ, NIOO-CEME, TNO B&O.
The NODC-i distributed data access infrastructure became fully operational in early 2009.

Alg@line/ALG@BASE - flow of monitoring data from observations to data products

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The Alg@line consortium collects environmental parameters and phytoplankton information with innovative, high-tech ferrybox systems in the Baltic Sea. Several installed ferrybox systems produce vast amounts of concurrent data of the state of the environment. Information based on this data is of huge interest among scientists, policy makers and general public. Thus from the early beginning of Alg@line dissemination of the results and the usability of the measurement values have been key issues.

The Alg@line system is modular which makes its continuous development relatively easy. This enables the choice of the best suitable components and technologies for each purpose.

Labview-based Ferrybox-software controls flow-through and sampling equipment onboard. Datasets are sent from the ships via ftp for further processing on land. After automatic quality control the flow-through data is stored into ALGABASE database. Nutrients contents are analyzed and phytoplankton species composition are determined from water samples in laboratories on land and then inserted into the same ALGABASE database.

A special software, PhytoWin2, is used for phytoplankton analysis. HELCOM species list is an integral part of the determination of species composition. It is maintained in the SUMPPU database and syncronized among PhytoWin2 and ALGABASE.

ALGABASE administrator's web interface is the tool for further quality checks, calibration and compilation of new parameters. Other users can access ALGABASE via Scientists Desktop Tool (SDT) which combines data from different data sources and gives a variety of user defined views to the data. For the automatic generation of web products variety of software products are used.

Modularity of Alg@line infrastructure and the use of relational database allow rapid deployment of technical innovations within the system. This ensures improving services and up-to-date products to the end-users.

Data Acquisition from Heterogeneous Instruments - A Centralized Approach

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The paper describes architecture of data management system (DMS) for real time data acquisition. The DMS is built around a centralized approach for data acquisition, monitoring, data storage and assimilation tasks. The general idea is to use retransmitted over TCP data streams from the RS232 ports of standard oceanographic instruments to the central real time acquisition software installed on one or more front-end processors. In this case all instruments are virtually in one place. This provides feedback between data centre and measurement stations for appropriate adjustment, reconfiguration, monitoring and testing of equipment with producers provided software. Abolition of the need of local computer resources or complex data loggers leads to a lower cost solution. This approach also simplifies time synchronization of various data streams. In this way multiple oceanographic instruments from different providers can be easily plugged into an existing system.

The proposed DMS architecture is used in development of Port Operational Marine Observing System (POMOS) build under the request of the Bulgarian Maritime administration. The pilot implementation uses one server and two front-end computers. The following standard software was installed: WIN 2008 Server, Win 7 ; MS SQL2008 ; Drivers for communication controllers, installed on every front-and computer which simulates remote RS232 port transmission over the TCP; Manufacturers' software for all instruments installed on each front-and computers (currently in the range of plug in instrumentations are: Visalla meteo, SeaBirth, RDI , SonTek, Miros).

The following application software was developed for 3 levels of the DMS:

Data acquisition level - a data acquisition program is running in real time at this level. The program has two modes - synchronous and asynchronous. Synchronous mode is controlled by timer events to scan synchronously the COM ports for instrument with single measurements. The data obtained are recorded along with the time from program timer in the database. There is a table for each specific instrument. Synchronous mode operates with an excess of information - information is collected every 2 minutes. Thus, in case of a momentary disruption of communication with some of the instruments data can be filled with the nearest previous data sample. Asynchronous mode is used for data acquisition from instruments with long period of measurement and averaging. In this mode COM ports communicating with these devices are working in asynchronous mode, i.e. the program does not scan them regularly, but it is on standby. When one of the instruments is ready to transmit a message, the program accepts data and stores them in the database. The time of reception is considered to be the last event from the program timer.

Data base level – real time data received in data acquisition level are directly stored in data base. Furthermore, preliminary data quality control (testing a minimum, maximum, range, etc.) is carried out. Database maintenance includes scheduled back-up and automatic recovering.

WEB application level – at this level a web portal operates for publishing the results of the measurements in real time with many panels: main panel in tabular form with last data from all observing stations; panel of graphic controls (thermometers, potentiometers, slide controls) for visualization of values; tabular and graphic panels, presenting the data within the last 24 hours; panel with geographical visualization of the measurement. For registered users the access to the report server is provided to retrieve the full historical information from the database. The historical data are available in tabular and graphic form. There is also a web service providing direct access to the database for users programs in order to automate (scheduled) extraction of relevant information.

The main benefits of proposed architecture can be summarized as: complete control of the system from a central site; simple integration of a wide range of instruments; lower cost software solutions for oceanographic data acquisition systems; easy expanding of an existing system with new instruments.

Bulgarian Port Operational Marine Observing System

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The Bulgarian Port Operational Marine Observing System (POMOS) is a network of distributed sensors and centralized data collecting, processing and distributing unit. The system is designed to allow for the real-time assessment of weather and marine conditions throughout the major Bulgarian ports: Varna, Burgas and Balchik, supporting thereby Maritime administration to secure safety navigation in bays, canals and ports. Real-time information within harbors is obtained using various sensors placed at thirteen strategic locations to monitor the current state of the environment. The most important for navigation weather and sea-state parameters are measured: wind speed and direction, air temperature, relative humidity, atmospheric pressure, visibility, solar radiation, water temperature and salinity, sea level, currents speed and direction, mean wave's parameters.

The system consist of: 11 weather stations (3 with extra solar radiation and 4 with extra visibility measurement), 9 water temperature and salinity sensors, 9 sea-level stations, two sea currents and waves stations and two canal currents stations. All sensors are connected to communication system which provides direct intranet access to the instruments. Every 15 minutes measured data is transmitted in real-time to the central collecting system, where data is collected, processed and stored in database. Database is triple secured to prevent data losses.

Data collection system is double secured. Measuring system is secured against short power failure and instability. Special software is designed to collect, store, process and present environmental data and information on different user-friendly screens. Access to data and information is through internet/intranet with the help of browsers. Actual data from all measurements or from separate measuring place can be displayed on the computer screens as well as data for the last 24 hours. Historical data are available using report server for extracting data for selectable place and period from database. The POMOS is developed in the frame of academic-government partnerships and represents an important resource to the Bulgarian ports. In addition to providing operations and safety-critical information to the Maritime administration, POMOS will serve as a scientific tool and a platform for further developments.

GODIVA: a 4-dimension implementation of DIVA

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Griding oceanographic fields is a frequent task in geophysical sciences. In the frame of the SeaDataNet project, the DIVA (Data Interpolating Variational Analysis) software is used by several groups to produce the regional climatologies.

Basically, Diva performs 2-dimensional spatial analysis of in situ data, most often in horizontal sections. In order to automate the operations necessary for the creation of a climatology, a set of bash scripts, called GODIVA, was written. With this tool, it is now possible to perform analysis on the vertical levels and on the time corresponding to a region and a period of interest.

To facilitate the steps of data extraction, tools working on the ODV-Spreadsheet were designed. The user simply provides a list of informations (time bounds, coordinates, variables, etc.) and one or several ODV-Spreadsheet(s), then data files in the correct format are generated.

In this work, the effort are concentrated on the description of the parameters and the input files required for a execution of the GODIVA routines.

SISMER activities: The French NODC -National Oceanographic Data Centre

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SISMER is an IFREMER department. It ensures the archiving and management of marine scientific data and related information. In the framework of the International Oceanographic Data and Information Exchange (IODE), SISMER was designated by UNESCO's Intergovernmental Oceanographic Commission (IOC) and is the National Oceanographic Data Center (NODC) for France.

To best serve both national and international communities, SISMER operates databases covering numerous oceanographic fields, with data from research vessels, geophysics, geology, ocean chemistry and physics, operational oceanography, etc.

Managing oceanographic data involves the following stakes:

- guaranteeing that observations performed remain available over time,
- ensuring that distributed data are consistent and compliant (in terms of format, quality),
- making marine data more accessible by setting up networks of data centers.

This poster describes the activities of SISMER. It details the various databases operated by Sismer, shows how they are linked and their relationships with the EU projects SeaDataNet, GeoSeas and MyOcean

French cruises catalogue
SISMER has catalogued nearly 5,800 French ocean research cruises and over 300 simple or surveys in transits, since 1913.
In the past, cruises were generally conducted by the former Scientific and technical fisheries institute (ISTPM) and by the French Navy's hydrographic and oceanographic service (FRENCH NAVY/SHOM). Later, other organizations like the CNRS, IRD (formerly ORSTOM), IPEV (formerly IFRTP), National museum of natural history (MNHN), National center for exploitation of the oceans (CNEXO) and then IFREMER (created by merging ISTPM-CNEXO) greatly contributed to the efforts to collect measurements at sea, using their own facilities. Currently, the growing number of European projects and international programs for ship time sharing mean that a number of French cruises are made aboard foreign vessels. (http://www.ifremer.fr/sismer/index_UK.htm)
Physical oceanography archiving database
The physical oceanological data archived at SISMER concern data collected at fixed location in the ocean (vertical profiles collected from CTDs or bottle sampling and time-series collected from current meters, sediment traps or tide gauges ...) and data collected underway along the ship track (Ship borne ADCP, Thermosalinometer).

The main measured parameters are: temperature, salinity, dissolved oxygen, nutrients, current speed and components, sea-level, etc. The physical and chemical database contains more than 300 parameters.
The data archived at SISMER have been collected during French scientific sea cruises or during foreign cruises in the frame of joint programs. They are checked and validated by the scientific teams responsible for collecting them.
Moreover, through exchange agreements between SISMER and the World Data Centre, WDC-A, in Washington, French scientific teams have access to all the hydrographic available data set.

The data set is divided into different subsets:

1) The CTD vertical profiles of temperature and salinity with, at some stations, other optional records such as dissolved oxygen or nephelometry.
2) The bottle data with a more limited number of samples on the vertical. Chemical measurements (eg. nutrients, chlorophyll, nutrients, PH, Alkalinity, etc may be present.
3) Time-series data. These data are collected on moorings at a fixed location. The most frequent data are currentmeter time-series: speed and direction (or the two speed components, North and East), at a given point and depth sampled at regular time intervals, generally every hour. Currentmeters are often equipped with other sensors to measure temperature or pressure.

In the frame of the SeaDataNet Project, this database will be linked to other European databases and its content will be available through a single portal.

Bathymetry and Geosciences database
The objective is to compile, to maintain, to archive and to distribute geophysical data collected by the French civil Research Vessels in coastal and open ocean areas. The data concerned are 1) Multibeam & single-beam echosounder bathymetry 2) gravity & magnetism 3) Multibeam echosounder reflectivity 4) seismic reflection 5) side scan sonar and the related navigation data. The main sources of data are the data collected of board the French research vessels managed by Genavir – a subsidiary of Ifremer. The database holds the 500 cruises with multibeam bathymetry data, 700 cruises with single beam bathymetry, 450 cruises with gravimetry data, 350 cruises with magnetism data

Data access
All the data described above are available through a one stop shopping portal named Nautilus. (http://www.ifremer.fr/sismer)

Operational oceanography
Sismer is in charge of operating two data management facilities for operational oceanography.
Open Ocean in situ observing component:

1) the Coriolis data centre http://www.coriolis.eu.org
2) Coastal Operational Oceanography data centre (CDOCO is the in situ component of Previmer http://www.previmer.org).

The objectives that have been assigned to Coriolis and to the Coastal Oceanography in situ component of Previmer is to provide, in a timely fashion (near real time or in delayed mode), the in situ data needed by the modelers for their assimilation and validation needs. By linking to various data sources such as Argo project, moorings projects, sea surface observed data, meteorological data and other data such as river flows, Coriolis and CDOCO provide a stop shopping for in situ data.

Geographical and reference data
The objective of the Sextant database is to provide an access service to reference data and geographical data. The Sextant portal aims to gather and to make available geographical and image data that can be used by stakeholders, scientific users and other final users in the fields of marine biodiversity, management of coastal areas, fisheries, deep sea and costal environments, marine geosciences. (http://www.ifremer.fr/sextant)

Online trend analysis using R in Nest – a decision support system for nutrient reduction in the Baltic Sea.

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The semi-enclosed Baltic Sea surrounded by nine countries with more that 85 million inhabitants on its drainage basis is severely influenced by eutrophication, which has been a great concern. Since the 1970s, the Helsinki Commission (HELCOM), the intergovernmental organization responsible for overseeing the protection of the Baltic Sea environment, has adopted several recommendations to reduce inputs of eutrophying nutrients (1).

Since the effects of eutrophication are the result of nutrient transport and transformations in number of different systems around the entire Baltic Sea, it is essential to understand the links between these systems. Integrated modeling approach has arisen as a valuable tool for environmental decision support, and models can be used to communicate to the public and policy-makers the linkages between parts of the systems and between natural and human- induced changes.

The decision support system - Baltic Nest - has been designed as a tool for developing and testing strategies to reduce eutrophication in the Baltic Sea and to provide scientific basis for decision making at international negotiations.

The whole system is designed as a web distributed system, which has access to large amounts of diverse types of environmental data allocated in different institutions, is capable to run different kind of models, and provides users with an easy way to evaluate different modelled scenarios and environmental data.

As a distributed system the Baltic Nest consists of a client-side Java technology-based program (Nest itself) and several web services, allocated on different application servers, which provide the client program with variety of data and modelling results. One of the important features of the system is an ability to access oceanographic databases and provide tools to analyse this information in different ways.

Large amount of oceanographic data for the Baltic Sea has been collected in the common Baltic Environmental Database – BED (2) – created in 1990 and maintained by the Baltic Nest Institute, Stockholm University. The database contains data collected from virtually all data “makers” around the Baltic Sea since 1877 and now comprises more than 250 thousand stations with almost 3 million hydrographical records and 750 thousand hydrochemical records. This database is accessible through a web service and a user of the Nest system can extract data as time series for specified polygons in the sea. This obtained from the database information can be evaluated as raw data as well as integrated values (averaged in time, in space). For trend analysis of time series of the marine data the statistical software R (3) is used. R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and Mac OS X. This open-source statistical environment is widely used and accepted by scientific community. But typically it is used to analyse data locally, on the user computers. To incorporate this software into the distributed decision support system Nest the application server Rserve (4) is used. The data, extracted from the database by the web service (implemented as a Java servlet) are then also processed by the application server running Rserve and R software and then both the requested data and results of statistical analysis are transferred to the client side for visualisation and further analysis.

Due to the web distributed architecture, the decision support system Nest allows to expand its capability by including other models and datasets and is freely available for scientific community and public.

The Baltic Sea Action Plan (5) launched by the regional environmental commission, HELCOM, contains very ambitious and concrete measures to restore the Baltic from eutrophication. The decision support system Baltic Nest has been used for these calculations in close cooperation with the HELCOM secretariat and many member states.

The decision support system Baltic Nest is available at http://nest.su.se/nest

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Use of light on-line GPS drifters for surface current and ice observations, related services

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Family of lightweight (less than 15kg-s), longlife (up to 3-4 months) and lowcost drifters are developed by Tallinn University of Technology and local engineering companies. Such buoys have rugged and simple housing construction, diameter about 11cm and length 1m. Buoys are equipped with GPRS based two-way communication, thus are programmable during the mission. Data are transferred in real time into one or several FTP-s for operational use in currents and ice models, both assimilation and validations. Such buoys are used also for in situ estimates for drift of surface objects and ice dynamics properties, drift estimates, compacting, ridging etc. Real-time (on-line) data transfer is performed via GPRS protocol, typically 15 minutes (can be also other intervals) into FTP, from where data are ready for use in model assimilation or other operational services – navigation in ice, ice charts, oil spill drift etc. Sea ice parameters, which can be observaed with these buoys are mainly ice drift properties, but also compacting, dynamics of leads and ship channels, dynamics of sigle ice fields, floes, etc. Buoy data are shown in real time on special webpage.

Extensive validation experiment of oil spill forecast system SeaTrackWeb and drift of the buoys was performed in 2007. Results showed that best coincidence between STW an drifting buoy was about 40 m/h. In average the departure was slightly in excess of 100 m/h. It was also investigated the relation betwenn the behaviour of buoy and behaviour of different oil fractions, also sensitivity of the buoy to direct wind forcing. There wasfound no noticable difference when fresh oil or floating object with 0 extra wind factor have been used in STW, which indicates that buoy does not possess direct wind drag. In certain cases adding extra wind factor will improve the comparison between buoy STW and observed buoy trajectory

Our on-line GPS drifters had shown good operational performance with low running costs.

Session 3 - Interoperability and standards in Marine Data management

Oral presentations

Information infrastructure for the Australian Integrated Marine Observing System

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Marine data and information are the main products of the Integrated Marine Observing System (IMOS, www.imos.org.au) and data management is therefore a central element to the project's success. The eMarine Information Infrastructure (eMII) provides a single integrative framework for data and information management that will allow discovery and access of the data by scientists, managers and the public. The initial strategy has focussed on defining specific data streams and developing end-to-end protocols, standards and systems to join the related observing systems into a unified data storage and access framework.

IMOS data streams can be categorized in four ways:

1) gridded data from satellites and HF radar systems
2) timeseries data from moorings, argo floats, gliders and ships of opportunity
3) image data from Autonomous Underwater Vehicles
4) biological data from continuous plankton recorders and acoustic tagging

1) and 2) provide real-time and delayed-mode data sets whereas 3) and 4) are delayed mode delivery only.

The IMOS data management infrastructure employs Open Geospatial Consortium (OGC) standards wherever possible. The main components of the system are:

- OpeNDAP /THREDDS servers hosting CF-compliant netCDF, HDF or Geotiff data
- The opensource GeoNetwork (http://geonetwork-opensource.org/) Metadata Entry and Search Tool (MEST) for metadata cataloguing. Much of the development work for this tool was carried out by the BlueNet project (www.bluenet.org.au) with subsequent development goes on in association with Commonwealth Science and Industrial Research Organisation (CSIRO).
- SensorML, which provides standard models and an XML encoding for describing sensors and measurement processes
- the opensource DataTurbine (www.dataturbine.org), data streaming middleware providing the foundation for reliable data acquisition and instrument management services
- A web portal using the opensource ZK Ajax framework (www.zkoss.org) and the OpenLayers geospatial framework (http://openlayers.org/) incorporates access to Web Services.

Additional storage formats and database protocols (e.g. WOCE exchange format, oracle) accommodate the data sets not readily converted to netCDF, such as video imagery generated by Autonomous Underwater Vehicles.

A distributed network of OPeNDAP/THREDDS servers around Australia forms the primary data storage. This complements the regional nodal structure of IMOS and allows rapid access to data by the local research community. Each local server also supports the GeoNetwork catalog with, wherever possible, automatic harvesting of metadata from the OPeNDAP/THREDDS system. An IMOS netCDF standard ensures that all necessary metadata to comply with ISO 19115 can be automatically harvested from the netCDF files on the THREDDS servers. Automation of metadata creation from

non-netCDF datasets is also being investigated. A master GeoNetwork catalog at the University of Tasmania routinely harvests new metadata records from the regional catalogs to maintain a central registry.

The IMOS Facility for Automated Intelligent Monitoring of Marine Systems (FAIMMS) uses DataTurbine streaming middleware to deliver real-time data from a sensor network across the Great Barrier Reef. However, the software is also being used provide a real-time view (through the portal) of all IMOS timeseries data collected within the preceding month or two.

The portal acts as a 'shop-window' to view IMOS data and as a data search engine utilising the GeoNetwork MEST. At present three 'views' of IMOS data are being developed: the real-time view through DataTurbine; a 'Facilities' view whereby all data from an IMOS facility, e.g. gliders, can be explored; and a 'Node' view whereby all data within an IMOS regional node, e.g. Southern Australia, can be explored. Through the GeoNetwork MEST the search engine can allow simple and complex data searches, both of IMOS data and other national and international datasets. Accompanying the different views of IMOS data is a 'software toolbox' including, for example, a MATLAB 'IMOS toolbox' (http://code.google.com/p/imos-toolbox/) for the end-to-end processing of fixed moorings data. All IMOS data is freely available without constraints and is obtainable through a simple self registration process.

Data storage and retrieval in IMOS is designed to be interoperable with other national and international programs. Thus, it will be possible to integrate data from sources outside IMOS into IMOS data products, and IMOS data will also be exported to international programs such as Argo, Oceansites. Also, most of the real-time physical parameters data will be exported to the World Meteorological Organisation's Global Telecommunications System (GTS).

As the IMOS program gains momentum the concept of data sharing and its value is spreading across Australia. The long-term view of the data management infrastructure developed for IMOS is that it will become the infrastructure of the Australian Oceans Data Network.

OCEAN DATA PORTAL: Current status and interoperability with other ocean data systems

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Timely access to quality data is essential for the understanding of marine processes. The International Oceanographic Data and Information Exchange (IODE) programme, through its distributed network of National Oceanographic Data Centres (NODCs), is developing the Ocean Data Portal (ODP) to facilitate seamless access to oceanographic data and to promote the exchange and dissemination of marine data and services. The ODP provides the full range of processes including data discovery, evaluation and access, and delivers a standards-based infrastructure that provides integration of marine data and information across the NODC network.

The key principle behind the ODP is its interoperability with existing systems and resources and the IODE is working closely with the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) to ensure the ODP is interoperable with the WMO Information System (WIS) that will provide access to marine meteorological and oceanographic data and information to serve a number of applications, including climate. Following the IODE-XX recommendations high priority has been assigned to the interaction with the SeaDataNet infrastructure (SDN).

The ODP is currently deployed in five data centres from the Back Sea region. Further datasets will be contributed to ODP by data centres in the USA, Canada, Australia, UK and the East Asian region by early 2010. The ODP web site is available at www.oceandataportal.org. This site provides background information on the project, software, documentation and training materials in addition to assistance to users on how to use ODP and how to become ODP data providers. The ODP user entry is available at http://www.oceandataportal.net.

The architecture of the Ocean Data Portal consists of three basic software components: Data Provider, Integration Server and ODP Services.

The Data Provider processes the local data sets and automatically generates the discovery metadata and transport data files on Integration Server requests or time-scheduling manner. These services are based on the OPeNDAP data (point, profile and grid) structures and specific metadata model based on ISO 19115. The Data Provider has possibility to support a various types of the data granularity, i.e. makes it possible to create discovery metadata, search and deliver full datasets or specified data pieces (logical data units) of datasets - single cruise or data profile, single buoy or single coastal station data - and etc. The data granularity level is adjusted in the process of the local dataset registration.

The Integration Server provides registration and operation status monitoring of the distributed data sources, harvesting of the discovery metadata in coordination with Data Provider, management of the common codes/dictionaries and access to distributed data sources by ODP services.

The ODP Services have responsibility for administration, discovery, viewing, analysis and download. The Ocean Data Portal includes a GIS-based user interface, metadata and data search, data download and visualisation components. The ODP services include a number of W3C and OGC web-services.

The Ocean Data Portal will deliver a standards-based infrastructure to provide integration of marine data and information from a network of distributed IODE NODCs as well as the resources from other participating systems. It will serve to coordinate the view of ocean data resources with other developing systems such as WIS, GEOSS, Sea Data Net, IMOS and ESIMO. This interoperability will be achieved through the use of internationally endorsed standards and it will not be a requirement for data centres to change their internal data management systems.

SeaDataNet - Pan-European infrastructure for marine and ocean data management: Unified access to distributed data sets (www.seadatanet.org) – Technical Aspects

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SeaDataNet is a leading infrastructure in Europe for marine & ocean data management. It is actively operating and further developing a Pan-European infrastructure for managing, indexing and providing access to ocean and marine data sets and data products, acquired via research cruises and other observational activities, in situ and remote sensing. The basis of SeaDataNet is interconnecting 40 National Oceanographic Data Centres and Marine Data Centers from 35 countries around European seas into a distributed network of data resources with common standards for metadata, vocabularies, data transport formats, quality control methods and flags, and access. Thereby most of the NODC's operate and/or are developing national networks to other institutes in their countries to ensure national coverage and long-term stewardship of available data sets.

The majority of data managed by SeaDataNet partners concerns physical oceanography, marine chemistry, hydrography, and a substantial volume of marine biology and geology and geophysics. These are partly owned by the partner institutes themselves and for a major part also owned by other organizations from their countries.

The SeaDataNet infrastructure is implemented with support of the EU via the EU FP6 SeaDataNet project to provide the Pan-European data management system adapted both to the fragmented observation system and the users need for an integrated access to data, meta-data, products and services. The SeaDataNet project has a duration of 5 years and started in 2006, but builds upon earlier data management infrastructure projects, undertaken over a period of 20 years by an expanding network of oceanographic data centres from the countries around all European seas. Its predecessor project Sea-Search had a strict focus on metadata. SeaDataNet maintains significant interest in the further development of the metadata infrastructure, extending its services with the provision of easy data access and generic data products.

Version 1 of its infrastructure upgrade was launched in April 2008 and is now well underway to include all 40 data centres at V1 level. It comprises the network of 40 interconnected data centres (NODCs) and a central SeaDataNet portal. V1 provides users a unified and transparent overview of the metadata and controlled access to the large collections of data sets, that are managed at these data centres.

The SeaDataNet V1 infrastructure comprises the following middleware services:

- Discovery services = Metadata directories and User interfaces
- Vocabulary services = Common vocabularies and Governance
- Security services = Authentication, Authorization & Accounting
- Delivery services = Requesting and Downloading of data sets
- Viewing services = Mapping of metadata
- Monitoring services = Statistics on system usage and performance and Registration of data requests and transactions
- Maintenance services = Entry and updating of metadata by data centres

Also good progress is being made with extending the SeaDataNet infrastructure with V2 services:

- Viewing services = Quick views and Visualisation of data and data products
- Product services = Generic and standard products
- Exchange services = transformation of SeaDataNet portal CDI output to INSPIRE compliance

As a basis for the V1 services, common standards have been defined for metadata and data formats, common vocabularies, quality flags, and quality control methods, based on international standards, such as ISO 19115, OGC, NetCDF (CF), ODV, best practices from IOC and ICES, and following INSPIRE developments.

An important objective of the SeaDataNet V1 infrastructure is to provide transparent access to the distributed data sets via a unique user interface and download service.

In the SeaDataNet V1 architecture the Common Data Index (CDI) V1 metadata service provides the link between discovery and delivery of data sets. The CDI user interface enables users to have a detailed insight of the availability and geographical distribution of marine data, archived at the connected data centres. It provides sufficient information to allow the user to assess the data relevance. Moreover the CDI user interface provides the means for downloading data sets in common formats via a transaction mechanism.

The SeaDataNet portal provides registered users access to these distributed data sets via the CDI V1 Directory and a shopping basket mechanism. This allows registered users to locate data of interest and submit their data requests. The requests are forwarded automatically from the portal to the relevant SeaDataNet data centres. This process is controlled via the Request Status Manager (RSM) Web Service at the portal and a Download Manager (DM) java software module, implemented at each of the data centres. The RSM also enables registered users to check regularly the status of their requests and download data sets, after access has been granted. Data centres can follow all transactions for their data sets online and can handle requests which require their consent. The actual delivery of data sets is done between the user and the selected data centre.

Very good progress is being made with connecting all SeaDataNet data centres and their data sets to the CDI V1 system. At present the CDI V1 system provides users functionality to discover and download more than 500.000 data sets, a number which is steadily increasing.

The SeaDataNet architecture provides a coherent system of the various V1 services and inclusion of the V2 services. For the implementation, a range of technical components have been defined and developed. These make use of recent web technologies, and also comprise Java components, to provide multi-platform support and syntactic interoperability. To facilitate sharing of resources and interoperability, SeaDataNet has adopted the technology of SOAP Web services for various communication tasks.

The SeaDataNet architecture has been designed as a multi-disciplinary system from the beginning. It is able to support a wide variety of data types and to serve several sector communities. SeaDataNet is willing to share its technologies and expertise, to spread and expand its approach, and to build bridges to other well established infrastructures in the marine domain.

Therefore SeaDataNet has developed a strategy of seeking active cooperation on a national scale with other data holding organisations via its NODC networks and on an international scale with other European and international data management initiatives and networks. This is done with the objective to achieve a wider coverage of data sources and an overall interoperability between data infrastructures in the marine and ocean domains.

Recent examples are e.g. the EU FP7 projects Geo-Seas for geology and geophysical data sets, UpgradeBlackSeaScene for a Black Sea data management infrastructure, CaspInfo for a Caspian Sea data management infrastructure, the EU EMODNET pilot projects, for hydrographic, chemical, and biological data sets. All projects are adopting the SeaDataNet standards and extending its services. Also active cooperation takes place with EuroGOOS and MyOcean in the domain of real-time and delayed mode metocean monitoring data.

SeaDataNet Partners:
IFREMER (France), MARIS (Netherlands), HCMR/HNODC (Greece), ULg (Belgium), OGS (Italy), NERC/BODC (UK), BSH/DOD (Germany), SMHI (Sweden), IEO (Spain), RIHMI/WDC (Russia), IOC (International), ENEA (Italy), INGV (Italy), METU (Turkey), CLS (France), AWI (Germany), IMR (Norway), NERI (Denmark), ICES (International), EC-DG JRC (International), MI (Ireland), IHPT (Portugal), RIKZ (Netherlands), RBINS/MUMM (Belgium), VLIZ (Belgium), MRI (Iceland), FIMR (Finland), IMGW (Poland), MSI (Estonia), IAE/UL (Latvia), CMR (Lithuania), SIO/RAS (Russia), MHI/DMIST (Ukraine), IO/BAS (Bulgaria), NIMRD (Romania), TSU (Georgia), INRH (Morocco), IOF (Croatia), PUT (Albania), NIB (Slovenia), UoM (Malta), OC/UCY (Cyprus), IOLR (Israel), NCSR/NCMS (Lebanon), CNR-ISAC (Italy), ISMAL (Algeria), INSTM (Tunisia)

The Development of an Operational Vocabulary Server

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Over the past decade there has been significant evolution of the semantic resources underpinning oceanographic data management in Europe. The practice of populating pan-European metadata fields from controlled vocabularies developed during SeaSearch, which was the predecessor of the current SeaDataNet distributed data system project. However, the content governance of these vocabularies was based on the decisions of individuals and their technical governance was based on loosely managed files resulting in multiple local copies of key vocabularies. Whilst these should have been identical, they rarely were in practice.

The first evolutionary milestone was encountered when the SeaDataNet community realised that if semantic interoperability were to be achieved, much stronger vocabulary management, based on all partners accessing a single centralised vocabulary resource, was required. Responsibility for the development of the necessary content and technical governance was given to BODC. Content governance based on group decisions was established by giving ownership of the vocabularies to SeaVoX, a group under the joint auspices of SeaDataNet and the IODE MarineXML Steering Group. This ensured that the vocabularies both developed to fulfil the requirements of SeaDataNet and that there was continuity of governance after the project was complete.

The second evolutionary milestone was the development of a centralised, fully maintained set of vocabularies accessible through a Web Service API, providing software tools with full time access to the latest vocabulary versions, which was achieved in 2005. However, the result fell far short of what would now be considered to be a fully operational system. Since then, the technical governance infrastructure has developed along the following evolutionary pathways:

- Governance Practice. In 2005 this allowed the correction of errors through the deletion of terms, which resulted in user system breakage. A policy was then introduced in which the terms were permanent but could be updated if their semantics were broadened, which was not universally accepted. Current policy is to correct errors following ISO practice flagging terms as deprecated with the enhancement of semantic linkage to the term to be used instead.
- Change Management. In 2005 the API served from a live database schema with changes visible on the Web within seconds of their being made. This developed into a procedure where two copies of the schema were maintained, with the web-visible schema updated by a nightly publication process, with formal version labelling of every daily change set.
- Robustness. In 2005 the Apache Axis Web Service application was set running with no infrastructure in place to assess whether the resulting services were in fact operational. Internal monitoring scripts were developed that initially reported problems by e-mail but later developed the ability to restart parts of the software stack as required.
- Interoperability. In 2005 the API looked like a Fortran subroutine interface delivering information as simple strings. These evolved into XML documents that in turn have developed into XML documents that conform to an external standard in the form of the Simple Knowledge Organisation System (SKOS).

The technology was developed to its current operational status between 2005 and 2009 as a part of the NERC DataGrid project under the UK e-Science programme. Further development is now planned as part of the semantic framework for the NETMAR FP7 project and as a NERC central service. The pathways for future evolution include:

- Developing a semantic resource bridging functionality through the extension of concept addressing to cover other namespaces.
- Providing standards-based infrastructure for the support of multilingual vocabularies.
- Formalising the version publication process.
- Working to develop and subsequently implement a standard for Vocabulary Server API syntax.

To summarise, in this paper we document the technological evolution of an operational system, present some lessons learned during its development and consider possible enhancements for the future that will upgrade the system without compromising its operational credentials.

IHO S-100 - the International data standard supporting marine and hydrographic data

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The IHO is the intergovernmental technical organization that, amongst other things, maintains a suite of international standards governing hydrography, nautical charting and digital hydrographic data. The IHO is the UN's recognised competent authority for these matters.

S-100 - the Universal Hydrographic Data Model became an active international standard on 1 January 2010. S-100 is the framework architecture for a contemporary standard for the exchange of hydrographic and related maritime data. S-100 is based on the ISO 19100 series of geographic standards and is fully compatible and interoperable with those standards.

S-100 is not limited to hydrographic data or hydrographic applications. It has been developed specifically to enable the widest possible range of users to use hydrographic data in conjunction with data from other maritime and marine domains. As well as traditional applications such as nautical charts and publications, applications based on S-100 already under development by non-IHO groups include sea ice forecast reporting, recording UNCLOS boundaries, and marine information overlays. These are applications that obviously encompass various hydrographic, meteorological and oceanographic parameters that go well beyond traditional navigation and hydrographic products delivered by national hydrographic offices. S-100 is intended to be a fundamental enabler for hydrographic input to Marine Spatial Data Infrastructures (MSDI) as well other developing marine information infrastructures such as e-Navigation.

The IHO has established an on-line S-100 registry and a supporting management framework that allows recognised contributing organizations to actively participate in the further development of S-100. Further details are available on the IHO website: www.iho.int

Interoperable Marine Data: Our Collaborative Future (BFF!)

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Until recently, the marine data community, like the marine science community, was dominated by stovepipe projects, lost data,and poorly described data sets. Despite successful international projects like ARGO and groundbreaking software and standards, the bulk of marine data management focused on standalone data sets, local knowledge, and idiosyncratic data presentation. Today, even with wide use of the world wide web and the best efforts of standardization agencies, past practices still remain the "standard" way to do ocean science, and data discovery and integration remain an art practiced by isolated scientists and their small technical teams.

The next 10 years will be different in every conceivable way, and will change the way "science as we know it" is performed and authored.

Many factors will drive the transition: the existence of the web, with existing and emerging technologies; scientific and human needs; organizational awareness and response; and the emergence of a new breed of ocean observatories all play a role. Possibly more significant will be the way these elements interact with each other, and with the many human communities that will benefit from them.

How can we respond, as individuals, teams, and collaborations, to make the most of these opportunities? By seeing the coming wave, we may prepare more effectively—to use it, and even to shape it. With examples and proposals, this presentation will attempt at least the first of these goals.

Interoperable Reference Information for Marine SDI

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Whilst many spatial data initiatives have been established for a number of years, realisation of the full potential of Spatial Data Infrastructure (SDI) remains elusive and there is still much work to do. This is no more or less apparent within the marine and maritime communities where progress has followed traditional paths and activity areas. Attention has been given to SDI for the coastal and marine domain from an academic perspective but there has been little in the way of broad scale or practical implementation. More tangible has been the development of standards (notably the International Hydrographic Organisation's S-57 and emerging S-100 standards) to capture and deploy nautical data to support electronic navigation. However, to date this has had a narrow focus and attempts to extend progress and knowledge gained from terrestrial SDI initiatives offshore have been limited in scope and practicality.

This paper is aimed at anyone who produces or uses marine spatial data. It references SDI theory and determines how this can be applied to the marine domain. The benefits of data re-use and sharing, consistency and management efficiencies that are realised when adopting SDI principles are explained. Advice on the practical steps needed for these principles to be applied to the rich diversity of hydrographic, oceanographic and other information that is present within many marine geographic applications is presented. The paper attempts to apply the many resources now available to geographers generally to the marine community when managing and using spatial data. It discusses how the implementation of SDI principles can help in the management of marine data and information as a whole and how SDI can be used to improve the wide range of products and services currently available, including those designed for navigation, now and in the future.

After introducing the components of SDI, including the role of the European INSPIRE Directive and how these can be applied to the marine domain, the paper focuses on core geographic content of Marine SDI. It identifies and comments on the status of marine reference information, based on feedback provided by end users and their experience of accessing and using it in a variety of applications (e.g. environment protection, marine planning, economic development, and risk management and mitigation). The practical steps that the marine community in the UK is now taking to create the highest practicable resolution datasets to support Marine SDI are explained, including how it is unifying similar but disparate sources of infrastructure data to create consistency, and utilising existing hydrographic surveys in high resolution bathymetry modelling to create higher level sea bed geology and habitat maps. Finally, the challenges and successes to date of using electronic nautical charts (ENCs) to create marine reference information and how this data can be modified to make it interoperable with terrestrial mapping and used as a foundation for application and business information is explored.

US IOOS Interoperability and Standards

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INTRODUCTION

The Integrated Ocean Observing System (IOOS) is a US government project led by the National Oceanic and Atmospheric Administration (NOAA). IOOS partners include multiple other federal agencies and a network of Regional Associations (RAs). The goal of IOOS is to provide sustained observational data and model outputs regarding the open ocean, coastal waters, and Great Lakes in the formats, rates, and scales required by scientists, managers, businesses, governments, and the public to support research and to inform decision-making. IOOS has begun implementing marine data management interoperability and standards at key NOAA data providers, and also supports data collection and data management efforts by the Regional Associations. The overall architectural approach is a distributed, service-oriented architecture based on open standards from the Open Geospatial Consortium (OGC), the International Organization for Standardization (ISO) and others. This talk will discuss interoperability efforts to date and future plans.

The work described below was performed in the context of several customer groups at NOAA but is not limited in any way to those groups -- the data are publicly accessible, and the data services and formats are based on open interoperability standards. The initial customer focus areas were: Coastal Inundation, Harmful Algal Blooms, Hurricane Intensification, and Integrated Ecosystem Assessments.

DATA ACCESS SERVICES AND ENCODING CONVENTIONS

IOOS identified three general classes of scientific information to target first -- in situ feature data, gridded coverage data, and images of data -- and recommended a web service and encoding convention to be used in each case. These recommendations were intended to standardize a small number of data access methods and thereby to enable a single client application to obtain data from multiple providers, and to harmonize the representation of data from different providers.

For in situ observations such as those from buoys, fixed sensors and volunteer observing ships, IOOS uses the Open Geospatial Consortium (OGC) Sensor Observation Service (SOS) [1] serving data and metadata encoded in Extensible Markup Language (XML). The XML employs a Geography Markup Language (GML) [2, 3] application schema based on the OGC Observations and Measurements (O&M) specification [4]. We implemented the SOS "core operations profile," which allows users to request data, observation metadata, and service metadata.

For serving gridded observations (including ocean color from satellites, surface currents from high-frequency radar, and model outputs), IOOS adopted both the Data Access Protocol (DAP) [5] and the OGC Web Coverage Service (WCS) [6]. Both protocols are suitable for accessing regular grids; DAP also supports irregular grids. WCS is explicitly called out in the GEOSS architecture and is supported by some commercial off-the-shelf (COTS) Geographic Information System (GIS) tools. DAP is well used in the NOAA scientific community and has been approved as recommended standard by the IOOS DMAC steering team. In practice, many IOOS data providers have used a software package (THREDDS Data Server) that supports both DAP and WCS. IOOS recommends that gridded data be encoded in Network Common Data Form (NetCDF) [7] with Climate and Forecast (CF) conventions [8].

For images of data, IOOS recommends the Web Map Service (WMS) [9], which generates georeferenced visualizations (i.e., “maps”) upon request to the user's specifications. WMS is an OGC specification and an international standard (ISO 19128) [10].

DATA PROVIDER IMPLEMENTATIONS

The initial IOOS data providers are the National Data Buoy Center (NDBC) at NOAA's National Weather Service (NWS), the Center for Operational Oceanographic Products and Services (CO-OPS) in NOAA's National Ocean Service (NOS), and the CoastWatch program in NOAA's National Environmental Satellite Data and Information Service (NESDIS). NDBC, CO-OPS and CoastWatch are all considered real-time data assembly centers (DACs) in that they provide access to current (or very recent) observations rather than historical data.

NDBC assembles data from several buoy networks, including NWS meteorological platforms, the Deep-ocean Assessment and Report of Tsunamis (DART) warning buoys, the Tropical Atmosphere/Ocean (TAO) array for global climate studies, and a subset of observing platforms operated by the IOOS RAs.
Real-time in-situ observations of ocean currents, temperature, salinity, water level, waves, and surface winds from these buoys have been made accessible using Sensor Observation Service (SOS).

Also at NDBC, gridded surface currents computed from coastal high-frequency radar (HFR) observations of Doppler shifts have been made available using DAP/WCS. Images of the surface current vectors have been made available using WMS.

CO-OPS operates a variety of fixed stations as part of the National Water Level Observation Network (NWLON) and the Physical Oceanographic Real-Time System (PORTS). Real-time observations of ocean currents, temperature, salinity, water level, surface winds, air temperature, and barometric pressure, and predictions of water level, have been made accessible via SOS.

At CoastWatch, gridded chlorophyll concentration derived from ocean color observations by the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Aqua satellite have been made available using DAP/WCS.

The IOOS Regional Associations (RAs) are now establishing SOS to serve in situ observations from buoys or fixed stations and DAP/WCS to provide model outputs.

NEXT STEPS

We have begun to establish a Registry of IOOS data provider service instances. Metadata from these services will be harvested regularly to populate a Catalog of IOOS data holdings, and we will establish an associated web-based Viewer to provide easy discovery of and access to IOOS data.

We are enhancing the metadata available about sensors and datasets in ISO 19115 and OGC SensorML [11] formats. We are augmenting semantic interoperability by adopting controlled vocabularies and identifier conventions for such elements as dataset names, sensor identifiers, geospatial features of interest, and thematic keywords. We are defining Capability Maturity Levels for data and service providers.

We plan to bring additional datasets and data providers online to support new customers, including biological observations for fisheries stock assessments. We also hope to establish additional service types such as format conversion and coordinate transformation.

At the international level, IOOS observations are a US contribution to the Global Ocean Observing System (GOOS). We would like to work more closely with projects such as the WMO Information System (WIS) to agree to interoperable and service-oriented approaches where possible. We are already in technical communication with MyOcean in Europe and the Integrated Marine Observing System (IMOS) in Australia on such matters.

Nationally, NOAA is collaborating with other federal agencies including US Geological Survey, Environmental Protection Agency and US Army Corps of Engineers to help standardize or interoperate with their data management practices. Also, we have an ongoing collaboration with the National Science Foundation's Ocean Observatories Initiative Cyber-Infrastructure (OOI-CI) project to provide observations from existing assets into the OOI-CI data exchange on behalf of numerical modelers.

ACKNOWLEDGMENTS

A project of this magnitude cannot be accomplished without many participants--too many to list everyone by name. I thank my colleagues in the IOOS office, developers and managers of the data provider and customer projects, the members of the IOOS technical working groups, and collaborators from the IOOS Regional Associations, NSF OOI/CI, OGC, Unidata, and other federal agencies involved in IOOS.

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Ocean Scenario in HUMBOLDT project: The use of Data Harmonization tools in forecasting and handling marine oil spill events in Europe

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and all Ocean partners involved in the project.

1. Introduction

The GMES funded project HUMBOLDT aims to contribute to the implementation of a European Spatial Data Infrastructure (ESDI). An infrastructure that integrates a diversity of spatial data that is available in a multitude of European organizations from various domains. To achieve this objective and to maximize the benefits gained from this integration, the requirements of INSPIRE, of GMES, of the environmental agencies and of other related activities in the EU will be met.

In practice, the HUMBOLDT project contributes to the creation of an ESDI by focusing on developing a framework for data harmonization and service integration. The main objectives are:

- To stimulate the transsectoral, translingual and transborder usage of geospatial data;
- To develop a common infrastructure of tools, approaches and standards to support transformation needs;
- To support INSPIRE (with tools for data harmonisation) and GMES (theme specific services enabling wider usage of data).

The oceanographic and marine domain is represented in this project by a selection of SeaDataNet partners (IFREMER, CLS, HCMR (HNODC), BODC and MARIS). The partners develop together one of the “scenarios”, the Ocean scenario, aiming to demonstrate the use of the HUMBOLDT data harmonization tools in forecasting and handling marine oil spill events. Further harmonization should improve a wider use of (out of domain) geospatial datasets in the oceanographic applications.
The project runs from 1/10/2006 – 30/9/2010, and therefore is now in its final year, a good time to look to the initial project results, the lessons learnt and the value of the results for the ocean and marine domain.

2. The HUMBOLDT approach and framework results

The HUMBOLDT project aiming to solve harmonization issues follows two approaches:

1. The application-driven approach
(Identification of user requirements, proof of concept in different domains via scenarios, and evaluation of framework against user requirements);

2. The technology-driven approach
(Technical concept of possible solutions, implementation, and evaluation of the technical framework, contributions and use of standards (OGC, W3C)).

The targeted harmonisation issues are related to:

- data formats
- coordinate reference systems
- conceptual schemas (data models)
- classification schemes

- scales / resolutions / level-of-detail
- metadata profiles
- natural languages
- multiple representation of the ‘same’ spatial objects
- spatial consistency issues at the border (edge-matching etc.)

The harmonization of datasets regarding the above issues is supported by the following set of tools developed under de HUMBOLDT framework:

- GeoModel Editor (Assisting to model geospatial datasets in classes and attributes)
- Alignment Editor (Creating the mapping from source to target model)
- Mediator Service (Executing a workflow of processes)
- Workflow service (Creating a workflow as input for the Mediator service)
- Executing actual transformation services (WPS) like:
    - Conceptual Schema Transformer (Executing the mapping from the Alignment Editor when requested)
    - Edge Matching Service (Assisting to match the edge of geographic areas or lines)
    - Coordinate Transformation Service (Transforming coordinate systems)
    - Language Transformation Service (Assisting in transforming languages of the attributes)

Important part of the harmonization processes is the mapping /transformation from source to target model after both the source and target have been specified. The HUMBOLDT software is able to perform this transformation automatically once this mapping has initially been specified by an application expert. From then on requested datasets can therefore be supplied in the required standard and easier be used in various applications.

3. Ocean scenario results

The ocean partners have become involved in the HUMBOLDT project for many reasons including:

1) users know requirements for harmonisation issues;
2) the present level of expertise in the ocean community;
3) the diversity and the complexity of oceanographic information which has to be provided to users: static spatial data, time dependant data from observing, monitoring and forecasting systems,

The Ocean partners in the HUMBOLDT project work towards developing an application to test and illustrate functionalities of the framework as far as it is relevant to their domain including the framework components: the Ocean scenario.

More specific the scenario focuses on the use of data from observing systems, e.g. pollution reports, and on static spatial data on threatened sensitive areas such as “Protected Areas”. This illustrates the possibility of the Humboldt framework to develop web services able to harvest and download sets of data in a harmonized format on the fly from distributed and heterogeneous sources. The INSPIRE specifications on Protected Areas according to the data model published in July 2009 by the INSPIRE Working Groups is the harmonized format for this data type.

The final demonstrator will be a central geographical user interface (on top of OGC services) displaying datasets from the 3 regions selected by the partners: Aegean Sea, North East Atlantic, North Sea and Mediterranean Sea. Each partner has a catalogue of datasets that can be browsed and displayed and the datasets, which normally are in different formats, will be displayed (and can be requested) in harmonized format.
The most important part of the application consists in the implementation of the HUMBOLDT harmonization tools. This means that the used datasets will be modeled with the GeoModel Editor, the mapping made with the Alignment Editor (HALE), after which it will be executed by the Mediator service calling the Conceptual Schema Transformer (CST). As supporting layer at least also SeaDataNet CDI V1 datasets (harmonized to HUMBOLDT ISO 19139 metadata profile) will be displayed.

Though this final product is a (temporary) demonstrator it will leave important results in the organizations. Not only did the partners get familiarized with the OGC services, they have also the ability to serve harmonized datasets to a wider community than only the oceanographic community. Application developers will find it easier to include other out-of-domain datasets serving improved products to their users.

While working towards this demonstrator the contribution of the Ocean scenario partners to the project is:

1. To supply domain specific requirements concerning harmonization issues;
2. To inform the project teams of the approach and results concerning (meta)data harmonization in the ocean and marine domain;
3. To test the output of HUMBOLDT in the oceanographic applications;
4. To familiarize with the latest developments regarding the OGC services;
5. To learn working in the field of data harmonisation on an abstract level: E.g. by working with conceptual data models, schema transformations etc;
6. To disseminate this knowledge in the oceanographic domain.

During the presentation the most recent developments will be illustrated, as well as some practical examples of use of the HUMBOLDT tools.

4. Conclusions

The work of the Ocean partners in HUMBOLDT has been a learning project for the partners, as well as an important contribution to the project regarding the supply of domain specific requirements and solutions.

Learning
The approach of the HUMBOLDT project has been very technology driven (more than application driven) and based upon an abstraction level (both in specification of tools as well as in modeling) that was unfamiliar to a large part of the consortium. This caused communication to be difficult and the project to start off slowly. The learning curve was steep on both sides. And the set of tools developed in the Humboldt Framework opens promising ways to view and to access harmonized geospatial information from distributed and heterogeneous sources. This is an important added value of which the different domains can definitely benefit when developing products.

Contribution
It was very important to stress the difference between the “standard” terrestrial geospatial datasets (like rivers, forest areas, houses etc) and the 2D, 3D, 4D oceanographic datasets. The Ocean scenario partners have supplied important requirements to the HUMBOLDT framework developers about the specific oceanographic data formats and conventions (ODV ASCII and NetCDF CF as standards) as well as in terms of contribution to the Humboldt framework in developing Web services allowing the extraction and downloading of NetCDF CF datasets.

Open issues
Compared to the existing solutions in the Ocean domain, one of the main open issues is the lack of a central vocabulary service for standards terms used in attributes of terrestrial datasets. This would make multilinguality a less important issue.
Another important open issue is the status of the framework components at the end of the project. HUMBOLDT does not aim to leave us with a full set of finished products that can immediately be used, but it has set up an Open Source fundament for further developments in the next years. Since the first results are promising developers in the Oceanographic and Marine domain should definitely keep an eye on next versions. The use will be supported by the INSPIRE directives as well as the outcome of the INSPIRE working groups, who will finish the Annex III target schema’s of marine and oceanographic datasets in the next years.

For more information:
- www.esdi-humboldt.eu (general project website)
- Or http://community.esdi-humboldt.eu/ (for quick information about Framework tools)
- Or contact MSc. P.R. Thijsse (Peter): peter@maris.nl

Russian State System of Information on the Global Ocean: Status and Application of the System for Support of Marine-Related Activities

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The Russian Federation's (RF) Unified State System of Information on the Global Ocean is aimed to:

+ ensure interaction between RF agency-level information systems performing collection, processing, accumulation and dissemination of information on the marine environment and marine-related activities;
+ form and maintain the unified information space on the Global Ocean on the basis of information provided by the above systems;
+ provide integrated and multidiscipline data and products to ministries and agencies, regional and local authorities, marine-related organizations;
+ interact with international marine information systems.

ESIMO is based on interaction between marine information systems of RF Emergencies Ministry, RF Foreign Ministry, RF Ministry of Defense, RF Ministry of Education and Science, RF Ministry of Industry and Energy, RF Federal Service for Fishery, RF Ministry of Transport, RF Ministry of Economic Development, RF Federal Service for Hydrometeorology and Environmental Monitoring, RF Space Agency and Russian Academy of Sciences. In 2008 the first portion of the system was put into routine operation.

ESIMO is supported by the Organizations-Centres of the system with an adequate mandate given by the RF Ministries and Agencies mentioned above. Their operation is regulated in terms of operating procedures and rules, scope of work, content of information provided to ESIMO. Currently 19 Centres are operating on a permanent basis.

ESIMO uses two categories of information technologies: thematic and system-wide.

Thematic information technologies are implemented by the staff of ESIMO Centres to form ESIMO information resources through interaction with observation systems, data sources and other resources of agency-level information systems. ESIMO Centres use more than 80 thematic technologies. All the technologies are documented, and the description of software, data bases, computational models and techniques is stored in ESIMO.

System-wide information technologies are used to ensure information interaction between ESIMO Centres and to provide integrated information on the Global Ocean and marine-related activities to ESIMO users. These technologies make it possible to maintain and use:

+ Virtual Telecommunication Network for protected data exchange between ESIMO Centres and ESIMO users through application of Virtual Private Network (VPN) tunnels;
+ ESIMO Centralized Metadata Base (CMDB) containing information on resources available in agency-level information systems and ESIMO Centres. This information is used to search required data and products;
+ base of common classifiers and codes to standardize various coding systems, used in data bases of ESIMO Centres;
+ System of Distributed Data Bases (SDDB) in the form of a network of remote data bases in ESIMO Centres forming ESIMO information resources;
+ ESIMO electronic map basis used for ESIMO user "map-based" interfaces and for provision of geo-related information;
+ Internet portal to provide information services to ESIMO users.

ESIMO SDDB plays a key role allowing users to access data bases of ESIMO Centres geographically distributed and heterogeneous both in content and form as a single whole. SDDB is supported by the Data Provider and Integration Server software.

Data Provided is located on servers of ESIMO Centres and makes local data accessible through registration and automated mapping of local data into ESIMO information resources. To involve a new

data source into ESIMO information space it suffices to install and set up Data Provider in the respective data source organization. Recently a service for registration local data in ESIMO without installation of Data Provider in a data source became available.

Integration Server is responsible for ESIMO information resources management. It is located on the server of RIHMI-WDC-ESIMO Centre.

ESIMO information resources cover all disciplines related to research and exploitation of resources of the Global Ocean. Currently SDDB integrates more than 160 data bases on more than 350 parameters – observations, forecasting and climatic information, oceanographic and ice information, information on pollution of seas and coastal regions, information on deployment of Russian ships in the Global Ocean, information on Russian ports and emergency situations in the seas of Russia, information on development of biological resources, etc.

This information is presented in ESIMO in the form of more than 1400 units of information resources (sets of information) with the total volume of not less that 5 Tb. ESIMO SDDB is a highly dynamical system. For example a lot of new information is added daily and 25-30% is fully updated.

Integration Server monitors the status of ESIMO information resources, i.e. once per day or as frequently as necessary it automatically checks all data sources and traces their availability as well as assess regularity of local data updating.

Information services are provided to marine-related activities by the ESIMO Internet portal (http://data.oceaninfo.ru), which serves as a system singly entry point. A user should only enter ESIMO with the help of a Web-browser using the above address to be able to search, select view and copy on-line the required data and products available in ESIMO SDDB to his/her computer.

Information

ESIMO contains a large volume of information on the situation in oceans, seas and coastal regions varying greatly in subjects and level of processing and provides a wide range of tools to obtain, view and present information. These resources and tools are not always required by users at the same time. For this reason a concept of user workstation (WKS) is implemented in ESIMO. WKSs provide access to different “slices” of the system on the basis of user requirements. A special component, called designer, is responsible for development of WKSs. Designer generates an individual mini-portal based on user requirements. User requirements can be formulated on the basis of data category – forecasts, climate data, and geographical region – Arctic seas or other things.

Among ESIMO users are federal and regional authorities, legal and physical persons, who need information on the Global Ocean for decision making or other uses. In terms of providing services ESIMO performs reference, information and applied functions.

Reference function is aimed to provide data on documented information on the Global Ocean available both in Russia and other countries. To implement this function a user should only access a respective section of the portal (Metadata) to be able to search, select and view on-line the required reference information on data sets, software, computational techniques and models, etc.

Information function is aimed to provide information to user on request through the portal and by subscription to any point of user location. With the help of a browser a user is invited to access the portal section “Data”, where a list of ESIMO information resources will be given. By the name of resources a user can have information on them, if necessary, come back to the “Metadata” section to clarify some characteristics and define criteria to filter data by time, parameters, geographical region, level of processing, data source. After search and receipt of data he/she can view and copy them on his/her computer for further use.

Applied function is aimed to provide tailored data and software applications in the form of user WKS to be used in institutions and maritime facilities for various marine-related activities

For example ESIMO WKS “Duty Shift of the National Crisis Management Centre” provides a set of services and information resources tailored for a specified task. Its key tool is the “Interactive Map” which makes it possible to view and analyze geospatial information varying in subjects (data of observations, forecasting and climatic information on wind and waves, currents and ice, information on location of ships and other facilities) and other aspects (country, administrative division, cities, ports).

Information from various ESIMO Centres is received through SDDB. In WKSs information is updated automatically at specified time intervals. In the above example information on location of ships is updated every 10 minutes, forecasting information is updated once per day.

ESIMO information technologies are used to build the oceanographic data portal to be used in IOC programmes.

A critical task in ESIMO development is to increasingly use standards of interoperability with other similar systems and to increase capabilities to provide marine information services to users. It is expected to develop tools for targeted services, i.e. provision of information for safety navigation, assessment of the marine environment conditions, etc. With this in view it is expected to improve services through wider use of modern information technologies.

MyOcean Information System : architecture and technical interfaces

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MyOcean (http://www.myocean.eu.org) is a 3-year project granted by the European commission within the GMES Program (7th Framework Program) whose objective is to provide a Core Service for the Ocean. This means myOcean is setting up an operational service for forecasts, analysis and expertise on ocean currents, temperature, salinity, sea level, primary ecosystems, ice coverage.

The production of observation and forecasting data is distributed through 12 production centres. The interface with the external users (including web portal) and the coordination of the overall service is managed by a component called service desk.
Besides, a transverse component called MIS (myOcean Information System) aims at connecting the production centres and service desk together,.manage the shared information for the overall system, and implement a standard Inspire interface for the external world.

The categories of information to be shared are :
+ Ocean products :
    - metadata for discovery and system configuration management (e.g. product lifecycle : demonstration, operational, retired, ...).
    - images (view)
    - data (download)
+ System monitoring and assessment :
    - production inventory
    - sub-components (production centres, service desk, MIS) availability and reliability.
    - user's transactions
+ In addition, ancillary information is required :
    - reference vocabularies (e.g. ocean variable names, ...)
    - registered users and authorizations

From a myOcean top level system requirement definition, the required information flows have been defined. How each component (production centres, MIS, service desk) is involved has also been defined from a top level architecture work.
This context will be reminded as an introduction.

From this requirements, working groups have been set up to define how technically speaking these interfaces will be implemented. These definitions rely on :

+ myOcean functional requirements,
+ work done on previous European projects (MERSEA, ECOOP, SeaDataNet, Boss4GMES, Marcoast...), European directives and interoperability requirement (Inspire, OGC, WIS, IOOS, IMOS, HMA...) or pre-existing working group (e.g. meteoOcean OGC)
+ technical constraints at production centres (available infrastructures, requirements from pre-existing services, e.g. at national, european or international level).

The chosen interface definitions (most of them among commonly agreed ocean or geo-spatial standards : netCDF/CF, OpeNDAP, OGC/CSW, OGC/WMS, OGC/WCS, ...) will be presented. The myOcean specific conventions agreed for internal interoperability within the system will be described as well.

At last, the tools (catalogue, download server, authentication/authorization framework, production and technical monitoring, user transaction accounting ...) which will be used or developed for managing the required information and provide interfaces input/output will be described.

At the time of IMDIS 2010, the architecture and technical requirements definition for myOcean Information System (MIS) will be done and consequently presented. The development and deployment phase will be on-going.

OceanSITES Data Management and Community Standards

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OceanSITES is a worldwide system of long-term, deepwater reference stations measuring dozens of variables and monitoring the full depth of the ocean from air-sea interactions down to 5,000 meters. An integral part of the Global Ocean Observing System, the growing network now consists of about 30 surface and 30 subsurface arrays. OceanSITES is led by research scientists and has participants from 20 countries. While the primary focus of the OceanSITES project has been on ocean circulation, hydrography, and surface fluxes, it is expanding to include more biogeochemical systems.

To efficiently and reliably ensure that OceanSITES data is accessible to scientists and the public, the Data Management team uses existing standards, protocols and frameworks whenever possible. They have adopted the Climate and Forecast (CF) specification for NetCDF, and are extending it to essentially create a profile for in situ ocean observatory data. While fully CF-compliant, the specification includes additional requirements for metadata to convey instrument-related and other provenance information.

OceanSITES has two Global Data Assembly Centers (GDACs), one at the National Data Buoy Center (NDBC) in the US and one at the French Research Institute for Exploitation of the Sea (IFREMER) in France. Both NDBC and IFREMER have extensive experience in managing and serving data from their independent partners; both have been using NetCDF for many years; and both operate Distributed Oceanographic Data Systems (DODS) servers, a framework for sharing data which is an implementation of Open Source Project for Network Data Access Protocol (OPeNDAP).

Using existing infrastructure, IFREMER and NDBC were able to rapidly develop a data management system that allows data to flow from Principal Investigators (PIs) of individual research projects, through regional Data Assembly Centers, to the GDACs and out to end users. Having duplicate data dissemination frameworks to provide access to and maintenance of the global timeseries datasets gives the project added security; the GDACs share data and synchronize catalogues on a periodic basis.

The Data Management team is collaborating on SensorML as a means of recording more structured metadata for planned use in the OceanSITES data cataloging and presentation services. This permits OceanSITES data providers to disseminate detailed documentation on data collection in a highly structured format, using external references to augment local descriptions of processes and instrumentation.

This paper will describe the extensions to CF that help ensure sufficient metadata for observational data, the structure of the OceanSITES data catalog, and the use of the Marine Metadata Interoperability project's Ontology Registry in the new SensorML specification.

Sextant: Marine Spatial Data Infrastucture

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In order to manage, share and retrieve geographical marine information to support multidisciplinary studies and decision making like coastal area integrated management, Ifremer built and set up the Sextant portal. It allows to easily share geographically referenced thematic information by providing online facilities such as:

- a catalog application to manage spatially referenced resources
- an interactive web map viewer
- download facilities

Several data sources are combined together in the system, including

- resident data
    * administrative information
    * shoreline ...
- multidisciplinary thematic data
    * environmental
    * physical or climatology layers
    * ...

Sextant allows exchange of spatial data and metadata since it has been designed to be compliant to the European Inspire directive and makes widely use of the Open Geospatial Consortium (OGC) and ISO TC211 standards. In broad terms, interoperability requires agreements on metadata schemas and formats, and service interfaces for accessing both data (visualisation and download) and discovery metadata.

In addition, advanced components have been developed to serve marine data :

- WMS and WCS for products such as oceanographic data model outputs and Digital Elevation Model. These environmental data imposes to manage spatial data with time and vertical components which are not, up to now, well managed by GIS because these datasets are four-dimensional (x-y-z-t).
- SWE (SensorML and O&M) is being implemented to describe and access observatories data sets. Environmental studies imposes to describe accurately the observing systems because users have to know the observation conditions to use them in good way.

From Blue Skies to Blue Seas – Realising the benefit of interoperability and standards

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Industries operating in the marine environment are reliant on the public and research sectors with respect to the delivery of many key data sets. Historically the science underpinning these data sets was not always reliable, however today the science underlying modelling, and the technology that allows data assimilation means that industry and the wider public have access to a vast array of data. However, the ability to integrate the data in a meaningful format to the ultimate end user relies on the ability to consume and process a vast array of data.

The oil and gas sector routinely undertake meteorological and oceanographic (metocean) measurements, which are utilised in conjunction with model data in support of safe operations. Although the underlying data are common with the research and public sectors, the way information is communicated in presentations is often very different. This paper describes how the utilisation of community tools and adoption of standards has lead to the development of a system to deliver any type of metocean data in formats that are accessible to both specialist and non-specialists.

The solution that was realised was developed from a weather forecast business, where many models use standard WMO formats such as GRIB and community tools and standards allow the consumption of these data into a range of community software products. The maturity of meteorological science can be linked to the availability of observational data derived from WMO initiatives such as the Global Telecommunication System, in addition to scientific programmes looking at specific processes.

A key issue facing measurement companies is that oceanographic and meteorological instrument manufacturers offer no standard data format, and also the industry has not adopted common processing or parameter naming. This diversity within oceanographic data stems from the lack of common standards which resulted from the lack of a coherent consumer group.

A review of the range of standards has enabled us to identify a well defined convention that allows us to promote its use amongst industry and to extend the parameters it contains for a broader audience. The adoption of this convention allows us to implement our own technological solutions whilst being able to integrate the broad spectrum of data being received together with being able to deliver standardised datasets to our clients. Several industry initiatives seek to make data available to the research community and this effort will expedite the transfer of data into the scientific community which can further its understanding from which industry will subsequently benefit.

As measured data are utilised to support safety critical operations in near real time, it is imperative that common quality assurance is applied to allow the user to be confident in its reliability. The level of quality assurance must be commensurate with the application of the data. As such several quality assurance standards have been investigated and presently we are working to promote QARTOD to the oil and gas community.

The work of the Open Geospatial Consortium has significantly helped in data visualisation in many domains (spatial and temporal). A significant challenge still lies ahead in getting software companies to fully implement the standards to permit their full functionality to be exploited.

The work effort described herein covers a framework from receipt of data, through application of data standards, quality assurance and visualisation. Despite the continuing evolution of options in the framework, this demonstrates that solutions are available right now.

Building an e-Infrastructure for Capture Statistics and Species Distribution Modeling: the D4Science Approach

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Data analysts and environmental scientists expect data to be available at ever shorter intervals and in ever greater detail. Their activities require collaborations across parties that are widely dispersed and autonomous. Moreover, these collaborations are often cross-discipline and require innovative research supporting environments that integrate data, processing and work-flows to produce new knowledge. They also increase the demand for interoperability, and some collaborative products and initiatives are already emerging, and are brought together in D4Science, e.g. :

- The Environmental community, where ESA provides GPOD interoperability, to share on demand geospatialdata such Sea Surface Temperature maps.
- The Biodiversity community, where AquaMaps enables biologists to create species prediction maps, integrating biological and environmental data.
- The Fishery management community, where extraction of information from statistical data sets combined with geospatial and environmental can improve catch estimates.

These collaborations imply an environment with the ability to load and archive various sources of data, to harmonize datasets by mapping correspondences, and to query across these datasets.

In the case presented here, Fisheries Resources Management has an ever increasing demand for capture data with ever finer geographical resolution, and an ever greater number of environmental variables to take into account. The management information process requires access to relevant documentation and source data. There is a need for innovative approaches that support the production of dynamic reports that integrate data from heterogeneous sources. These may be the result of complex aggregation, processing, analysis and editing of continuously evolving data. There also is the need to generate model-based, large-scale predictions of occurrence of aquatic species taking into account various environmental variables.

To support such demanding scenarios a promising approach is based on e-Infrastructures. By definition, an e-Infrastructure is a framework enabling secure, cost-effective and on-demand resource sharing across domain boundaries. A resource here can be “physical” (e.g. storage and computing resources) or “digital” (e.g. software, processes, data). It can be shared and interact with other resources to provide functions to its clients, that can be human or an application. Thus, an e-Infrastructure is the “mediator” in a market of resources and accommodates the needs of resource providers and consumers. An important feature of this mediator is the variety of solutions put in place to remove barriers related to the resources heterogeneity. thus facilitating their “smooth” consumption.
The infrastructure layer supports: (i) resource providers, in “selling” their resources; (ii) resource consumers, in “buying” and organizing resources to build their applications. Furthermore, it provides organizations with logistic and technical aids for application building, maintenance, and monitoring. A well-known example of such an e-Infrastructure is represented by the Grid, where a service-based paradigm is adopted to share and reuse low-level physical resources. Application-specific e-Infrastructures are in their turn inspired by the generic e-Infrastructure framework and bring this vision into specific application domains by enriching the infrastructural resource model with specific service resources, i.e. software units that deliver functionality or content by exploiting available physical resources.

The potentially unlimited availability of resources allows a new development paradigm based on the notion of Virtual Research Environment (VRE). A VRE is an integrated environment that provides seamless access to resources and offers facilities for communication, collaboration and interaction among scientists and researchers. This is built by aggregating the needed constituents after hiring them through the e-Infrastructure. The resulting research environments are organized 'views' built atop the pool of available assets, ranging from computers and servers to collections and services.

This presentation focuses on the implementation of this innovative approach in the context of D4Science (www.d4science.eu). D4Science is an EU funded project that started in 2008 (and has its roots in the DILIGENT project that started in 2004) aiming at developing a production-level e-Infrastructure capable of providing scientific communities (including the Fishery and Aquaculture Resources Management) with dedicated VREs to serve the needs of various challenging application scenarios. In October 2009, D4Science entered its second phase aiming at reinforcing the D4Science e-Infrastructure by adding interoperability facilities. These aim to develop data discovery, processing and sharing facilities bridging diverse autonomous e-Infrastructures. This will result ,in e-Infrastructure Ecosystems that potentially serve a significant set of communities dealing with multidisciplinary challenges whose solution is currently beyond reach.

The Establishment of an operational e-Infrastructure that supports VREs capable to satisfy the needs of the user communities calls for a paradigm shift in the way the communities operate. This involves at least three major areas: (i) the technology, (ii) the organizational model of the resources, and (iii) the human processes. These three areas are not independent, but any choice in one of them strongly influences and constrains the others. Progress in one area stimulates modifications and adaptations in the others, and also to start possible further changes in that area itself.

In this presentation the introduction of VREs is described starting from the technological perspective. Then the possibilities to collect, analyze, and organize data and the collaboration features are described.

From the technological point of view, the development of the software for e-Infrastructure-based VREs applications was complex and demanding in terms of effort and required resources. The applications are expected to provide on-demand, powerful and easy to use functionality for supporting scientific collaboration and in-silico experiments. The VREs now include services for storage, processing and presentation of potentially huge and heterogeneous datasets, but they also allow semi-automated transformations across different data schemas and formats. The entire array of standards and interoperability-oriented approaches underlying the D4Science technology will be presented discussed.

D4Science implements many standards and innovative technologies that serve the networked and distributed features. The majority of these are not directly perceived by end-users but they are distinguishing features of the the gCube system, i.e. the technology behind the D4Science infrastructure. The gCube technology was designed in accordance with second-generation Web Services standards including Web Services Resource Framework (WSRF), Web Services Addressing (WS-Addressing) and Web Services Security (WS-Security). For information management, the system is equipped with features to handle compound information objects consisting of multiple parts and alternative manifestations. These objects can have single or multiple metadata records in various schemas, e.g. Dublin Core, ISO 19115, AgMES.

The D4Science e-Infrastructure is in production mode since June 2008. Since then it has been populated with widely different resources, and the information resources published so far are quite heterogeneous. They range from multidisciplinary fisheries data sources, such as Fishery Country Profiles, National Aquaculture Legislation Overviews, Capture Time series graphs, species distribution maps, to very different Earth Observation products. The standards and interoperability-oriented approaches to guarantee a seamless consumption of these resources will be presented.
Four VREs have been created that serve the needs of different scenarios in the Environmental Monitoring and Fishery and Aquaculture Resources Management domains. These specific services will be presented to demonstrate the power and flexibility of the proposed approach.

D4Science-II will work toward the strengthening of the D4Science e-Infrastructure by making it capable to consume resources coming from other e-Infrastructures established in other areas as well

as sharing part of its resources with them. The resulting e-Infrastructures ecosystem will be a very rich space of resources that can be easily consumed in a seamless way thanks to the D4Science e-Infrastructure services. The D4Science pool of standards and technologies will be enriched with state-of-the-art data exchange capabilities. These will include the Statistical Data and Metadata eXchange (SDMX), Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) and Open Archives Initiative Object Reuse and Exchange (OAI-ORE).

As a consequence of this, the Virtual Research Environments that bring the power of the constituent resources in data processing and storage to users in an easy to understand and intuitive format, with minimal requirements on bandwidth and processing power.

Finally, the sustainability of the approach will be discussed. D4Science-II will introduce the new notion of “knowledge ecosystem”. This ecosystem is a community of e-Infrastructures that provide services. In the knowledge ecosystem vision the ”health” of a data e-Infrastructure is influenced by the “health” of the others since each of them affects, and is affected by, the modification and updates on the services provided by other e-Infrastructures. This may open the way to the adoption of alternative sustainability solutions. For example, the fact that each ecosystem e-Infrastructure has its own community that uses and enhances the ecosystem capabilities might imply that all these communities could federate to provide the support to maintain the entire ecosystem operation.

A standards set to share biodiversity data related to fisheries

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Ecosystem Approach to Fisheries (EAF) is an application of sustainable development that aims to improve the management of (over)-exploited marine resources by taking into account the numerous relationships between marine ecosystems' components (like food webs). It is very important in the context of EAF to share existing informational resources (IR) among stakeholders to set up effective management schemes. However these IR are distributed in many organizations and thus difficult to share. Moreover, they have been, so far, managed with heterogeneous formats in systems that are difficult to access, even at the scale of a single organization like ours. Standardization is thus required to imrpove ressources sharing.

The Mediterranean and Tropical Halieutic Research Center (CRHMT), in Sète, France, aims to improve and enhance EAF by sharing its IR more effectively. For years, CRHMT's work has focused on just a few top predators exploited by fisheries in a few marine ecosystems. This is just a small part of the whole set of IR needed for an EAF at a global or even regional scale. Therefore, a new IR management and sharing application will enhance our ability to collect the necessary resources and contribute to EAF worldwide.

By setting up a new information system (Ecoscope, http://www.ecoscope.org/), built on top of existing ones, the CRHMT can inventory, manage and share the various IR acquired during previous, ongoing and coming projects. This system aims to comply with current best practices in terms of standardization so as to become a node of a global network which facilitates the exchange of these IR among institute researchers, with our collaborative partners and to the wider public.

The architecture we implemented takes into account some of the recommendations of the World Wide Web Consortium Semantic Web activity to facilitate knowledge and metadata sharing, as well as recommendations of the Open Geospatial Consortium and TDWG that are specifically relevant to reach our goals. However, re-engineering our previous datasets handled in heterogeneous ways to serve them properly with standard data formats and related protocols is a challenging task. Indeed enabling syntactic and semantic interoperability requires a lot of work and attention to detail. Moreover, as our approach is generic and could be implemented in similar ecosystem management cases, we aim to share, or duplicate, this application in other contexts.

We set up an ontology schema for our domain by reusing specific parts of various existing schemas. For example, we aim to match with i) SPIRE ontologies for ecological concepts, with ii) Friend Of A Friend (FOAF) RDF (Resource Description Framework) schema for social networks concepts, with iii) Simple Knowledge Organization System (SKOS) RDF schema for controlled vocabularies concepts, and with iv) Dublin Core Metadata Initiative RDF schema for a simple metadata element set.

This presentation will focus on our ongoing work on food webs in marine ecosystems, the resulting knowledge base conceptual model (a UML (Universal Modelling Language) class diagram) and technical aspects of our current implementation (using the Web Ontology Language and Jena APIs (Application Programming Interfaces)). We will then give some examples of a Graphical User Interface we set up to satisfy different use cases. The need to aggregate raw data on fact sheets is addressed with geographic and network representations (e.g., foodwebs). Systems interoperability is assured by delivering part of our IR through web services like the Web Catalog Service (CSW) and the Web Map Service (WMS).

Posters

Data Management in COSYNA

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COSYNA is a project to construct a long-term observatory for the German part of the North Sea. Elements of the observatory should also be deployed as prototype modules in arctic coastal waters. COSYNA combines observed data from various sources in order to get an integrated view of the actual and - by means of forecast models - the future state of the seas. For the North Sea, the data acquisition within the COSYNA-frame will start in 2010.

The data-management in COSYNA has to provide the interoperability between the different types of data which is achieved with the aid of standards. Two different types of data were identified for which two methods of data storage will be used:

- Time-series like data (e.g. data from sea poles, buoys, ferry boxes, meteorological stations) are stored in an Oracle database.
- Map-like data (e.g. data from remote sensing, HF radar) will be stored in netCDF (Network Common Data Format) files, a community standard format for data storage. Whenever possible, the format should be conform to the CF (Climate and Forecast) conventions.

The metadata describing the data are organised within the metadata base system NOKIS (Nord-Ostsee Küsten Informations System) developed to support the data exchange between German coastal agencies and research institutes.

The full quality control (QC) takes several months after data-acquisition, because e.g. sensor-drifts and bio-fouling cannot be corrected immediately after the measurement, as they are not detectable at that instant. However, for assimilation of data into models a fast pre-operational quality control (QCPO) in terms of plausibility checks is performed in near real-time. The time-series-like data are numerically accessible using the OGC (Open Geospatial Consortium) standard 'Sensor Observation Service' (SOS) which is implemented by the application of algorithms developed by the OpenIOOS group to the Oracle database.
The access to netCDF files is accomplished by OPeNDAP (Open Source Project for a Network Data Access Protocol).
Both data types will be freely and anonymously available to any interested parties A data-usage disclaimer will show up to tell about fair usage.

The visualisation of data will be done via OGC web services and out of those the Web Map Service (WMS) and the Web Feature Service (WFS) will be used predominantly.

The utilisation of standards is favoured for the COSYNA data management. For the data a WMS will be used which creates dynamically the parameter maps for a single parameter of a Ferrybox transect. This is done using SQL-select statements for the Ferrybox measurement table. The 'where-conditions' for the data will be read from the metadata via 'Catalog Services for the Web' (CSW) another OGC standard. CSW is also used to write metadata, e.g. for any new Ferrybox transect automatically. A Java procedure combines the static metadata from a Ferrybox route template with dynamic data read from the database via SQL for that purpose.

A quite similar procedure is used for satellite data products like chlorophyll, suspended matter or yellow substance. These products are written as netCDF files. The metadata for every new product or

scene are written as combination of static and dynamic metadata using CSW similar to Ferrybox transects.

For netCDF files exists a Web Map Server called ncWMS developed at Reading e-Science Centre. This ncWMS is able to visualise data from variables of netCDF files directly even with curvilinear coordinate systems. The user interface called Godiva2 for ncWMS can merge all netCDF files from a directory.

The selection of a single scene is done by date and time. This works only if a common grid for all data is used and therefore every scene is projected to this grid. To keep the full pixel discrimnatory power every scene is written to a second netCDF file without performing a projection.

In addition a earlier developed non-standard applications are used for data visualisation. The time-series graphs of all COSYNA time-series stations are available at http://tsdata.gkss.de. Similar time-series plots including maps for COSYNA routes are available at http://ferrydata.gkss.de. Scenes are visualised at http://kofserver1.gkss,de/public.

COSYNA data management has the primary objective to build a data portal which integrates different data sources for a specific parameter. Search for data is done using CSW. Metadata contain use-metadata needed by web-services to allow access to the data.

The first results of this development will be shown

The adoption of SeaDataNet V1 technologies, standards and tools by the National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences

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SeaDataNet is the leading initiative in Europe, actively operating and further developing a Pan-European infrastructure for managing, indexing and providing access to ocean and marine data sets and data products, acquired via research cruises and other observational activities. The National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences (NIMH-BAS) is the Bulgarian National Centre of the World Meteorological Organization (WMO), which collects and automatically disseminates meteorological and hydrological data via the Global Telecommunication System (GTS). As a result of the routine activities of NIMH-BAS, many marine data sets have been observed and collected.

Marine data are stored according to the institutional functions and are in various formats, which makes it difficult when the data have to be analyzed further in the frame of the UP-Grade Black Sea Scientific Network FP7 Project.

NIMH-BAS will use the SeaDataNet V1 standards and tools in order to bring NIMH-BAS marine data centre to the same level of marine data management as the Black Sea Scientific Network of leading environmental institutes.

The poster presents the main functions of the Marine Data and Information management System of NIMH-BAS, a diagram of the marine data flow of services and products and the link to the Bulgarian National Oceanographic Data Centre (NODC).

Modern approaches to metadata development

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Research on development of metadata bases in Russia and other countries has been in progress since the 1970-s. The most well-known metadata bases are GCMD (NASA, USA), EDMERP (MARIS, the Netherlands), GECAD (RIHMI-WDC, Russian Federation), Centralized Metadata Base of the Unified System of Information on the Global Ocean (ESIMO CMDB, Russian Federation, http://data.oceaninfo.ru/meta/). A lot of experience has been gained in metadata collection, formalization, structuring, search and use. The review of this experience makes it possible to identify drawbacks of the existing metadata systems, make metadata classification, identify phases of data processing where metadata appear, identify levels of data management where different levels of metadata integration are required, and find promising approaches to metadata development.

The drawbacks of the existing metadata systems are:

- slow updating of information in metadata systems;
- uncoordinated changes in metadata objects leading to the following: metadata are inconsistent, there are duplicates (especially concerning institutions, experts, parameters) and outdated records, metadata objects are not always aligned with each other;
- inadequate functionality and automation of metadata maintenance system (remote entry of information on data based on the content management system is not always used);
- most of the systems are oriented to work with a single metadata object;
- there is no uniform metadata model for all metadata;
- metadata maintenance services developed on different principles;
- there is no clear understanding of a metadata description unit – metadata instance;
- a set of metadata objects is not complete; users need not only description of data sets, projects, cruises but also information on software, formats, methods, etc.

Users are not satisfied with the fact that metadata are isolated, inadequately structured (there are many unfilled fields), inconsistent and have duplicates and outdated records. Metadata objects do not always have automated links with each other. In this case even if a metadata base is well-organized it is very difficult to achieve adequate relevance and reliability of metadata. It is necessary to incorporate additional metadata objects (description of observation networks, technologies, methods of collection and processing, etc.) into the existing metadata systems.
There are several types of metadata

- system metadata – are used for data retrieval, conversion, download, documenting and for restriction of access to DB;
- descriptive metadata (thematic) – describe the meaning content of data (period of observation, data amount in logical and physical units); are presented in the form of general information on DB, information on data sources and information on data collection and storage units – cruises, stations, etc.
- interface metadata (metadata of services) – are used to describe screens and generate reports;
- metadata of processes – describes characteristics of data processing system (statistics on DB download, information on scheduled planning and processing, traffic, access rate, etc).

Metadata appears at different phases of data processing:

observations - at this phase the following is required: information on observation networks and methods of observations, methods and sites of instrument calibration; description of observation platforms, information on tools of measurement;

data collection - information on data collection technologies, data communication formats, communicated and received data, projects, and telecommunication system parameters;

data cataloguing - data sets, data owners, data users, collection formats, observation projects, parameters, methods of primary processing and quality control are described; information on data inventory units – RV cruises, satellite flights, etc. – is generated;

data accumulation - information on technologies, data sets, data bases, quality control methods, data exchange, formats, projects and programmes;

data storage and protection - information on data storage and protection;

data use - information on data use methods, space-time coordinates of observations, typical requests for data;

data analysis and assimilation - information on platforms, instruments, data quality, methods of observation, methods of primary processing;

environmental forecasts - information on data quality and methods of forecasting, generalizations;

climate processing - information on methods of data processing, quality control and analysis, software and hardware;

modeling - information on models, methods of modeling, model output formats;

data dissemination - information on screen forms of data presentation, data communication formats, documents being published, including those published in the Web environment;

decision support - information on services, rules of services availability, features of attributes.

As is seen at all levels of data management there are both reference information of the same type (information on data bases, data sources, formats etc) and reference information specific for each level.

Among promising approaches to metadata development there are some new solutions that can be proposed.

It is necessary to develop a wide range of interrelated metadata objects. For instance under the SeaDataNet project five metadata objects are being developed; within the ESIMO CMDB there are about twenty metadata objects. This is information on technologies, information resources – data sets and data bases, observation networks, data storage formats, institutions-data sources, observation platforms – hydrometeorological stations, research vessels and voluntary observing ships, buoys, satellites, methods, projects, parameters, terms. Establishing separate metadata objects makes it possible to considerably reduce duplication of information in various objects, to simplify the maintenance of data relevance and in visualization of any of metadata objects to represent information in more detail.

For many years a description of data sets and data bases has been considered to be the main metadata object. Unfortunately this object does not allow the whole range of metadata objects related to a given data set to be linked correctly. It is therefore proposed to consider a technology of processing of given data to be the main metadata object. The technology produces or uses data when they are collected, processed or disseminated. The technology is always related to one or several data sets (input data set and output data set or several input and output data sets). All these data sets should be represented in metadata. Each data set description should be linked with such metadata objects as institution, format, software, methods, etc. Each data set may produce one or several information resources. Each information resource should inherit a description of the data set from which it was derived.

It is proposed to group technologies by phases of processing. Therefore there are technologies for making observations, data collection, data processing, accumulation and storage and data dissemination.

Metadata should be organized on the basis of a centrally-distributed scheme. It means that metadata management within one domain should be organized on a centralized basis and storage especially for similar metadata objects (RV cruises, data set descriptions, project description) should be distributed between centres. For data exchange it is necessary to standardize data exchange formats (micro-formats) between systems on the basis of XML for all metadata objects as has been done under the SeaDataNet project for EDMED, CSR, EDMERP, CDI systems. Each institution presents these metadata on their Web-sites in a standardized form, and national and international data centres should collect these XML files and combine them into relevant metadata objects.

In metadata maintenance a uniform dictionary of parameters should be used which includes the following attributes: name, measurement units, parameter storage format, classifier and method used for parameter definition, abstract, etc. The dictionary should be used in various metadata objects (description of data set, information resource, instrument, software, etc.) in the process of data integration and applied processing.

In development of metadata common classifiers and codes should be used (ISO–19115, IOC, WMO, IHB). Any centre or user may use a local classifier, but it should be indicated. In this case the codes used in data exchange can be mapped.

An important point in metadata management is metadata status monitoring, i.e. automated control of entry errors, assessment of filling in fields, assessment of all metadata object descriptions, and information on the contribution of centres to metadata updating.

Even now the accumulated metadata allow conclusions on the progress of conversion of environmental data into digital form, therefore metadata maintenance technologies should include tools of aggregation of information on data placed in metadata bases. (amount of data sets by institutions, types of observations, observation platforms; logic units of data collection – stations, expeditions, observation platforms, profiles, parameters for a given period of observations, geographical region, institution-owner of data).

Metadata should be widely used in applied data processing, i.e. applications should actively use one or several metadata objects to provide to users required information on data sources, methods of environmental parameters definition, etc. For instance metadata should be used in the application “Monitoring of observation network”, in electronic-reference climate manuals.

The use of metadata from several sources for a wide range of metadata objects with the distributed structure is a strategic area in metadata development.

The proposed approaches have been used in implementation of ESIMO CMDB (http://data.oceaninfo.ru/meta/), International Polar Year portal (http://mpg-info.ru) and can be used in integration of resources in any domain.

Derivation of Standards for the UK Marine Environmental Data and Information Network (MEDIN)

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The UK Marine Environmental Data and Information Network (MEDIN) was established to improve access to and stewardship of UK marine data and information. Specifically, MEDIN aims to deliver secure long-term management of priority marine data sets in approved 'Data Archive Centres', and improved access to authoritative marine data held in this network through a central (discovery) metadata search capability. The MEDIN Standards Working Group has implemented a variety of standards and tools to achieve these aims. These include:

1) Discovery Metadata Standard. This standard is compliant with the ISO19115, INSPIRE and UK metadata standards and uses the ISO 19139 schema set for encoding in XML. The standard specifies the use of certain vocabularies to make it 'marine flavoured' such as the Parameter Discovery Vocabulary derived under SeaDataNet. A number of tools are in the process of being built to allow easy production of the XML which will then be harvested using a portal. These include an ESRI ArcCatalog plug-in, and on-line and desktop form based applications. An ISO 19757 (Part 3) Schematron schema has been developed to allow testing of MEDIN constraints in the content produced by any of these tools.

2) Data Guidelines. Each data guideline defines the data and information that must be stored with a particular data type to ensure it can be readily used and reused. As such these standards recommend controlled vocabularies and hierarchical structures to the data. MEDIN is currently considering the INSPIRE Environmental Monitoring Facilities schema to determine if a generic model can be applied to the Data Guidelines. Where possible we have used existing standards such as the ICES Data Type Guidelines produced by the ICES WG Data Information Management. The principle benefits of this suite of standards are:

- Allows a contracting organisation to easily specify a format that data should be returned in that can be readily used and includes all relevant attributes
- Provides a consistent format for contractors to work to (rather than a different format for each contract)
- Data can be readily exported to Data Archiving Centres and other users
- Instills good practice amongst users

3) Controlled vocabularies. Where appropriate MEDIN is recommending the use of controlled vocabularies to improve interoperability between data sets. Unsurprisingly this work builds heavily on the work that SeaDataNet has already achieved.

Where possible the standards have built on, and are complaint with, existing international standards which will improve interoperability outside of MEDIN into other domains. Some of these standards, tools and techniques are now being considered for adoption more widely in the UK, demonstrating the progress that the MEDIN Standards WG has made in this area.

The VLIMAR Gazetteer: a standard for marine geographic features

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In order to improve the access, uniformity and clarity of different marine geographic entities, VLIZ developed a standard, relational list of marine geographic names, coupled with information on the geographic location of these entities. This online-editable standardized list or 'gazetteer' contains at the moment almost 30,000 marine and coastal names such as seas, sandbanks, ridges, bays or even standard sampling stations used in marine research.

The VLIMAR gazetteer is served from a relational SQL server database where different geographic units can have one or more relations between each other. The structure of the database is an open hierarchy where each geographic unit points to one or more other units applying different relation types. This allows the use of multiple marine classifications such as the IHO Ocean and Seas Limitations or the Maritime Boundaries or EEZ's of the World. Alternative global marine classifications such as the FAO Fishing Areas, the ICES Ecoregions or the Large Marine Ecosystems of the world are also integrated and available in gazetteer. The geographic cover is global and contains very detailed information on the North East Atlantic and the Southern Ocean. The VLIMAR gazetteer has been proven to be most valuable not only a as a search tool for marine features, but also as a standard and geographic backbone for other coastal and marine data and information systems. Examples are the World Register of Marine Species (WoRMS), the MarBEF Data System and the SCAR-Marine Biodiversity Information Network. A geographic interface, available from http://www.vliz.be/vmdcdata/vlimar/ allows the user to search, query, visualize and download the geographic features in different formats like GML, GeoTIFF, Shapefile, KML, JPEG or SVG.

The Shipboard Automated Meteorological and Oceanographic System (SAMOS) Initiative Data Management System

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The data assembly center (DAC) for the SAMOS initiative (http://samos.coaps.fsu.edu/) has developed and implemented an automated data management system that collects, formats, quality controls, distributes, and archives near real-time surface marine data from research vessels. A SAMOS is a computerized data logging system that continuously records navigational (ship's position, course, speed, and heading), meteorological (winds, air temperature, pressure, moisture, rainfall, and radiation), and near-surface oceanographic (sea temperature, salinity, conductivity, and fluorescence) parameters while the vessel is at sea. The SAMOS initiative relies on the high-quality instrumentation purchased and deployed by the research vessel operators, and does not provide instrumentation to the vessels. Currently, the SAMOS initiative receives measurements recorded at 1-min intervals and derived from higher frequency samples (on the order of 1 Hz). As of 2009, 21 research vessels provide routine SAMOS observations to the DAC. The data management system automatically tracks progress of the daily data acquisition and quality processing, stores metadata on instrumentation and ships, and provides data monitoring capability via a user-friendly web interface. An SQL database stores essential parameters to support tracking, data quality control, and version control for each file throughout the process.

Presently, SAMOS data are acquired directly from research vessels at sea via a daily email transfer protocol. The steps of this NOAA-funded protocol will be described along with lessons learned through the development process. A new DAC initiative to develop a second SAMOS data acquisition protocol, via collaboration with the Rolling Deck to Repository (R2R; http://rvdata.us/) program, is now underway with funding from the U.S. National Science Foundation. The new protocol is envisioned to include transmission of the higher frequency meteorological and surface oceanic samples from participating vessels to real-time servers at R2R. The SAMOS DAC will access these samples for data reduction (averaging), shore-side monitoring, and quality control.

R2R envisions the U.S. academic fleet as an integrated global observing system that reports high-quality environmental data and documentation from all routinely-operated "underway" instruments to a central repository. Lessons learned from SAMOS will provide guidance to the R2R program as it develops procedures for data quality assessment and rapid feedback to vessel operators across a broad suite of instrument types (oceanographic, meteorological, and geophysical).

As part of the SAMOS data management system, extensive ship and instrumental metadata are collected from each participating vessel. We will outline the challenges encountered with various metadata collection methods (e.g., emails, web forms, etc.), and introduce a plan to automate this collection in the future. Additional topics will include the uses of standards for data formatting and distribution that facilitate future integration and our protocols to provide the observations to world data centers for long-term preservation (archival).

European Marine Observation and Data Network (EMODNET) – Pilot portal for Hydrography

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The European Commission has concluded service contracts for creating pilot components of the European Marine Observation and Data Network (EMODNET). The overall objective is to create pilots to migrate fragmented and inaccessible marine data into interoperable, continuous and publicly available data streams for complete maritime basins. The results will help to define processes, best technology and approximate costs of a final operational European Marine Observation and Data Network.

The EMODNET-Hydrography portal is one of the pilot portals, that is being developed. The portal will provide hydrographic dataproducts collated for a number of sea regions in Europe:

- the Greater North Sea, including the Kattegat and stretches of water such as Fair Isle, Cromarty, Forth, Forties,Dover, Wight, and Portland
- the English Channel and Celtic Seas
- Western Mediterranean, the Ionian Sea and the Central Mediterranean Sea.

Users will get access to the following geographical information system layers:

- water depth in gridded form over whole of maritime basin on a grid of at least quarter a minute of longitude and latitude
- water depth in vector form with isobaths at a scale of at least one to one million
- depth profiles along transects
- coastlines
- underwater features - wrecks, seabed obstructions etc

The portal is being developed with the functionality to allow the download of these data products for further analysis and use by users and to provide the data products as OGC services for use in other portals developed as part of the EMODNET preparatory actions for marine biology, marine chemistry, marine geology and marine habitats and beyond.

The portal development started in June 2009 and it is planned that the first release of the portal and hydrographic data products will be available to users from June 2010 onwards. Thereafter the quality of the hydrographic data products and portal services will be refined by integrating additional survey data, that might become available from other originators data sources, and by responding to user experiences with the portal. The overall pilot project has a 3 year duration.

Approach
The EMODNET - Hydrographic portal is being developed by a consortium, comprising members of the SeaDataNet network together with organisations from marine science, the hydrographic survey community, and industry. The partners combine expertises and experiences of collecting, processing, and managing of bathymetric data together with expertises in distributed data infrastructure

development and operation and providing OGC services (WMS, WFS, and WCS) for viewing and distribution.

SeaDataNet is a leading infrastructure in Europe for marine & ocean data management, initiated and managed by the National Oceanographic Data Centres (NODC's). It is actively operating and further developing a Pan-European infrastructure for managing, indexing and providing access to ocean and marine data sets and data products, acquired via research cruises and other observational activities, in situ and remote sensing. The basis of SeaDataNet is interconnecting Data Centres into a distributed network of data resources with common standards for metadata, vocabularies, data transport formats, quality control methods and flags, and access.
SeaDataNet is aiming for an extensive coverage of available data sets for the various marine environmental disciplines, such as physical oceanography, marine chemistry, biology, biodiversity, geology, geophysics and hydrography. This is implemented by seeking active cooperation at a national scale with institutes and at a European scale with communities, that are engaged in data management for these disciplines, and by seeking opportunities for including their data centres and data collections in the SeaDataNet metadata and data provision.

In the field of hydrography, a number of Data Centres in SeaDataNet already manage hydrographic data sets, such as multibeam surveys from scientific cruises. However there are several other parties engaged in the provision of hydrographic data. These comprise:

- Hydrographic Offices, that are responsible for surveying the navigation routes, fairways and harbour approach channels and producing from these the nautical charts on paper and as Electronic Nautical Charts (ENC), that are used for navigation. The HO's are members of the International Hydrographic Organisation (IHO), that has its data policy, which supports restrictions in the delivery of high resolution data sets, mostly for safety and security reasons. Moreover, nautical charts have a legal status. Every ship captain must use certified nautical charts and the production and publication of these is an activity which must follow stringent international procedures. The latter results in a condition that HO's are careful in delivering and distributing bathymetric survey data sets.
- Authorities, responsible for management and maintenance of harbours, coastal defences, shipping channels and waterways. These authorities operate or contract regular bathymetric monitoring surveys to assure that an agreed nautical depth is maintained or to secure the state of the coastal defences.
- Research institutes, that collect multibeam surveys as part of their scientific cruises.
- Industry, especially the energy industry, that contracts multibeam surveys for pipeline and cable routes (in case of windfarms) and the telecommunication industry for phone and internet cable routes.

It is essential to involve these organisations in the project to get access to additional data sets (single and multibeam surveys, sounding tracks, composite products), that will support a good geographical coverage and contribute to a higher quality of the hydrographic data products. Therefore the following approach is adopted for the implementation of the EMODNET - Hydrography portal:

- Involve research institutes, monitoring authorities, and HO's, in providing hydrographic data sets, only for internal use by project partners for producing regional Digital Terrain Models (DTM) with specific resolution (500 * 500 meters) for each geographical region. The regional DTM's are loaded and integrated as one DTM into the portals' spatial database;
- Include in the portal a metadata discovery service, by adopting the SeaDataNet CDI metadata standard, that gives clear information about the background survey data used for the DTM, their access restrictions, originators and distributors; this also ensures the connection of the Hydrographic portal with the SeaDataNet portal.
- Develop a high-end Hydrographic portal, outfitted with a powerful spatial database, that is outfitted with viewing services, downloading services and OGC services to serve portal users and remote servers, such as e.g. the other EMODNET portals, the prototype European Atlas of the Seas, and the broad-scale European Marine Habitats map.
- Provide via the portal public access to the data products and using the CDI metadata a way to identify which background survey data have been integrated into the hydrographic data products. Public access to the background data sets itself will not be given, but requests to originators will be facilitated using the CDI metadata. This way the portal will provide originators of hydrographic data sets an attractive shop window for promoting their data sets to potential users, without losing control.

This system and organizational approach has the following benefits:

- It facilitates an expansion of the geographical coverage of the EMODNET hydrographic portal to other seas, because this involves convincing data holders in other sea areas with the same principles and product services of the pilot;
- It facilitates an expansion of the base of background data sets used for the DTM productions with data sets from other data holders, such as more HO's, research institutes, and port & coastal authorities, and industry (energy and telecommunication industries), because the EMODNET model respects possible data access restrictions and distribution conditions as set by data providers to end-users, while the data sets are used internally by a select group of experts for producing and finetuning the DTMs for the regions;
- The one-stop-shop of SeaDataNet will be expanded with metadata references to hydrographic data sets, of which part can be downloaded directly from interconnected Data Centres via the SeaDataNet shopping mechanism and of which another part can be requested from their owners, whereby the SeaDataNet shopping mechanism will be of service for routing the requests.

The presentation will give background information on the project and EMODNET. Moreover it will highlight the progress made in the field of defining the principles for the QA/QC activities and DTM production, the portal functionality, the metadata service, and the data gathering.

Online services quality monitoring in the framework of SeaDataNet Project

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Within SeaDataNet project a wide diversity of data, data products and services was made available to scientific community. The scientists using this framework are able to search and retrieve data and products archived across a large network of participating Data Centers.

Two major aspects play a critical role for the effective operation of this framework : quality of managed data as well as the service level for the online user services set up by the project, such as data discovery, data access, data visualization via the SeaDataNet web portal and the distributed components of the system behind the portal.

Monitoring the online services to guarantee an agreed level is more and more a commitment for some projects funded by the European Commission like Research Infrastructure project (DG-Research) or Global Monitoring for Environment and Security (GMES - DG_Industry) which must be compliant with European directives such as the Inspire Directive (Infrastructure for Spatial Information in the European Community) .

Quality of available services is defined by a collection of "Service Level Agreements" (SLA in ISO 20000 / ITIL standard) which precise the different aspects of users' satisfaction. Within SeaDataNet, testing and controlling the availability of the services (online service is available when user wants to use it) have been implemented as a first priority since it is commonly known that it is a crucial point in implementation process of widely distributed systems over the Internet.

This continuous monitoring has been set up using Nagios (http://www.nagios.org/) software and additional pluggins to test the response of SeaDataNet system components through the availability of external interfaces such as web pages, web services, servers.

Results of these tests are logged and visualized as monitoring indicators : red when a problem occurs with a component , green if component is OK. Also the system produces continuously diagrams representing the evolution of the availability of servers and services as well as detailed statistics. In order to avoid biases due to from which location the monitoring has been performed, two Nagios servers have been installed (France and Greece) and monitoring results cross-checked to detect differences which are the consequences of network unavailability.

Benefits of this continuous monitoring are:

- In real time, to be able to raise alerts when incidents are detected and to correct them as soon as possible;
- In a longer term, to identify critical components within widely distributed systems and to update them to improve their robustness
- As statistics, to inform users and stakeholders of the system of the overall availability of provided services.

In the future, the system can be enhanced to monitor not only availability but also performance aspects in order to improve the effectiveness of the infrastructure and to estimate bottlenecks, performance lacks and other factors of malfunction.

Shipboard Data Stewardship: from Ship to Shore to Archive

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The increased volume and heterogeneity of scientific research data present new challenges for data managers tasked with the stewardship of those valuable data resources. Stewardship of in situ oceanographic data is especially important as those data form an essential part of the time-series observations comprising the full climate data set for planet Earth. Acquisition of oceanographic data by U.S. funded investigators often begins aboard a vessel in U.S. academic fleet and data are managed subsequently by individual investigators with the understanding that all data will be archived at the appropriate U.S. National Oceanic and Atmospheric Administration (NOAA) National Data Center. In late 2006, the U.S. National Science Foundation (NSF) funded the Biological and Chemical Oceanography Data Management Office (BCO-DMO) at Woods Hole Oceanographic Institution to work closely with investigators to manage data generated from their research projects and to ensure those data are permanently archived at the U.S. National Oceanographic Data Center (NODC). The Rolling Deck to Repository (R2R) project, funded by NSF in late 2009, has been tasked to work with vessel operators to improve stewardship of shipboard data routinely collected from suites of underway sensor systems and ensure final archive of those data at the appropriate U.S. National Data Center, e.g. the NODC or the National Geophysical Data Center (NGDC).

The R2R program is building an authoritative catalog of expedition-level metadata (cruise identifier, vessel name, ports/dates, project title, science party, funding awards, data set inventory, and ship track) for the in-service U.S. academic fleet, and will publish this content via lightweight, standards-based Web services that are easily consumed by partner data centers. The catalog relies on established international vocabularies such as the International Council for the Exploration of the Sea (ICES) vessel names; International Hydrographic Organization (IHO) sea areas and undersea feature names; and Internet Assigned Numbers Authority (IANA) domain names. R2R employs established service standards including the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH), Open Geospatial Consortium (OGC) Web Map Service (WMS), and OGC Web Feature Service (WFS) to publish catalog records, basemap images, and shiptrack geometries.

The BCO-DMO manages data collected during many of the same expeditions catalogued by R2R, and has developed a relational database that incorporates much of the same expedition-level metadata. Maintaining the cruise-context for research datasets aids data discovery and facilitates integration of discrete data sets. The two systems have developed independently, but can now incorporate open-source, standards-based technologies to enable machine-to-machine information transfer. Additional synergistic development is possible since content in both the R2R and BCO-DMO data repository systems is permanently archived at the appropriate U.S. National Data Center in accordance with mutually agreed upon data submission policies.

We will describe our use of established international vocabularies, metadata content standards, and Web services in developing data management procedures that scale to support the increased volume and complexity of data generated by modern oceanographic research programs.

Visualising and comparing distributed coastal oceanography model and in-situ data using standards-based web services

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Ocean scientists use highly diverse sources of data, including in-situ measurements, remotely-sensed information and the results of numerical simulations. Thus there is potentially a large amount of data available to tackle a given problem. The challenge is how best to integrate these diverse data sources in a manner which will not only provide an effective solution to the problem at hand, but which will maximize both interoperability with other projects and reuseability for tackling problems that still lie in the future.

We present a web portal and associated infrastructure that enables users to view and compare a diverse range of coastal marine data from numerical models, satellites and in-situ observations. The models vary in scale from the local (covering for example, a portion of the Black Sea), to the regional (such as one of the eastern North Atlantic). The data present in the models and in-situ observations span a number of disciplines and include temperature, salinity, currents, winds, waves, nutrients, ocean color, radiation and detritus.

We discuss our experiences in managing and integrating these diverse data sources, using a range of standards-compliant technologies and conventions. The model data are obtained via an Open Geospatial Consortium (OGC)-compatible Web Map Service (WMS), and the observed data are obtained via an OGC Web Feature Service (WFS). These services are located in different institutes, and the actual data is hosted at over 20 institutes across Europe. The use of CF-compliant NetCDF, Climate Science Modeling Language (CSML) and THREDDS/OPeNDAP are integral to the ease of data integration in the project.

As well as forming part of a large pan-European project (ECOOP), the web portal is being used as a test bed for development of a system for use by scientists and decision makers to detect and react to the prediction of hazards such as potentially harmful algal blooms in coastal waters. In this scenario the use of appropriate standards and conventions enables the combining of multiple datasets which gives greater confidence in the forecasting of hazards, as opposed to simply relying on numerical models alone.

Recopla : Data inventory and data management for marine geoscience data on the french continental shelf

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Knowledge of the French continental shelf is heterogeneous : the bathymetry of the french EEZ is well known for the deeper domain but insufficient to establish a reference state on the continental shelf.
Recopla consists of a modern continental shelf mapping project in cooperation with the oceanographic and hydrographic service of the French Navy. It will contribute to increase the knowledge necessary to establish reference data for the French/European marine strategy.

Marine geoscience data and metadata are managed in several databases at Ifremer. First of all, the raw data acquired during the oceanographic cruises, such as data from multibeam echo-sounders, side scan sonars, seismic systems, are archived by the French national oceanographic data center Sismer. Secondly, the processed data are archived in a specific database, especially for the seismic profiles. Finally, elaborated and interpreted data, such as bathymetric DTM, backscatter mosaics, sedimentological maps, are stored in the French georeferenced marine data server Sextant.

The first task of the Recopla project consisted of an inventory of the geophysical data and metadata available on the French continental shelf, and a classification of these data according the level of processing : raw, processed, interpreted, published.

Using a GIS, geophysical metadata were managed as profiles, providing position and acquisition information. The type of acquisition along each profile can be obtained by cross-referencing with the raw data databases.
For this exercise, acquisition tools were separated into five groups : bathymetry from multibeam echosounder, backscatters from multibeam echosounder, backscatters from side scan sonar, seismic from mud penetrator, seismic from seismic tools.
The second step was to know which profile is processed or not, interpreted or not. For that, we cross-referenced with the processed database for seismic data and with the georeferenced data server for bathymetry, backscatter mosaics and sedimentological cartography.

The results of the data inventory project show that the French Mediterranean continental shelf is better known than the Atlantic shelf. Multibeam echo sounder and seismic profiles were proccessed for all the cruises in the Gulf of Lion, mapping the entire shelf. On the other hand, in the Bay of Biscay and the Channel region, only few percent of the area were surveyed and many profiles need to be processed and interpreted.

The International Geo Sample Number as a Global Standard for Sample Identification

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Ambiguous naming of samples in the Geosciences has seriously impeded the linking and integration of sample-based data in distributed, interoperable data and information systems for marine as well as the terrestrial environments. The System for Earth Sample Registration SESAR (www.geosamples.org) operates a web-based registry that generates and administers the International Geo Sample Number (IGSN) as a globally unique identifier for Earth samples. Major repositories (e.g. ODP, WHOI, SIO, US Polar Rock Repository, Antarctic Research Facility, LDEO) have already registered their collections. Nearly 4 million samples are now the SESAR global sample catalog. Data systems such as the NGDC Marine Sample Catalog, GeoStrat, the Marine Geoscience Data System (MGDS), IODP, and the International Continental Drilling Program (ICDP) have implemented the IGSN or are in the process of doing so.

SESAR's primary objective in the near future remains to grow acceptance and use of the International Geo Sample Number by the science community on a global basis. In order to achieve this goal, (a) SESAR will continue to work with Ocean and Earth Science data systems on implementing web-service based registration of samples that will allow users to seamlessly and transparently register samples upon submission of data to these systems. Web-service based registration from client systems has already been developed for the GEOCHRON system. (b) SESAR will improve the registration process for individual users by developing new easy to use web-based as well as desktop and mobile device applications for capture, organization, and submission of sample metadata. (c) SESAR will promote a globally distributed network of registration nodes. SESAR plans to gather relevant members of the global Geoinformatics and data curation community in 2010 to plan the design, implementation, and operation of an international network of IGSN registration nodes. We hope to start a dialog with marine information and data systems at the IMDIS.

Electronic posters

Eurofleets european FP7 project

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European FP7 EUROFLEETS project started in september 2009. It aims in accordance with the recommendations of the Marine Board of the European Science Foundation (ESF, 2007) and in the frame of MarinERA to bring together the existing European Research Fleet owners and to enhance their coordination and cost-effective use of their facilities in order to support the efficient provision of essential research services for monitoring and sustainable management of the Regional Seas and Oceans.

Inside this project, a specific Work Package 10 (Up to date software to facilitate trans national access) proposes the joint development of an innovative and generic softwares portfolio combining all necessary functionalities for cruise preparation, for collection, processing and display of scientific data acquired during sea cruises, and for export of data and information to the main marine data centres and networks. Thus, this work package has strong interfaces with other european initiative such as SEADATANET.

It is proposed here to give a general presentation of the EUROFLEETS project with a special focuss on Work package 10.

Optimization of operation with databases an example of centre ESIMO (Unified State System of Information for World Ocean conditions)

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National Oceanographic Data Centre RIHMI-WDC (All-Russia Research Institute of Hydrometeorological Information - World Data Centre) for 45 years of the existence has gathered considerable sizes of the data about a state of the World ocean (more than 33 thousand sea expeditions, 7 million oceanographic profiles). All this data since 1997 is loaded in data base management system (DBMS) Oracle and intensively used at service of users of Unified System of Information for World Ocean conditions (ESIMO). For 13 years of maintenance of a DB, its constant development as on structure, and entirety, frequent change of developers the significant amount of difficulties was stored, such as:

- Presence of not used objects in databases (DB) schemas;
- Usage already five versions of DBMS Oracle, including on platforms of Windows and Linux;
- Lowering of access speed to a portal at the expense of increase in quantity of users and creation of the high traffic to a DB;
- Usage of several physical DB;
- Lowering reliability of data storage system;

For solution above-listed difficulties was set five main directions, including infrastructural have been defined also:

- Regulate of the data (elimination of duplicated and not used objects in the DB);
- Rise of speed access to data;
- Rise guard data storage;
- Data replication;
- Selection of a segment for testing.

For goal achievement of the first direction has been used the resource of DBMS Oracle Audit. By means of this resource during six months the data about usage of objects of a DB was accumulated. The size of the accumulated data has made some gigabyte. After the data has been accumulated, has been made analysis towards objects which were no calls neither users nor applications. Then objects which not used was separated from the total array.

The increase reliability of safety of the data is provided by construction of a logical standby DB on the basis of technology Oracle Data Guard and data warehouse which will be full up data on resources of technology Oracle Streams. In the presence of the standby DB any changes in the data, made the user or any application are instantly transferred in a logical standby DB to a separate server. When f the preferred server of a DB will be disabled it is substituted by a server with a logical standby DB that provides trouble-free work of portal ESIMO.
Data warehouse allows collect in one place all data National Oceanographic Data Center (NODC) of Russia. The data storage is planned to enlarge the data from the main DB which services portal ESIMO and from other DB. As for increase reliability of data storage is involved Oracle technology named RMAN (recovery manager) which allows to restore a DB after partial or complete loss the data in supernumerary situations.

Rise of speed data access through portal ESIMO (http://data.oceaninfo.ru) is supposed to be reached by creation of "mirror" of a portal in the Main computer centre (MCC) Federal Hydrometeorology and Environmental Monitoring Service (Moscow), In MCC there are more velocity channels that substantially should affect speed of access of users to portal ESIMO. Loading planned divide between

two platforms. For this purpose, on the second platform (mirror) planned to place a double of the integration server (for interaction with suppliers of the data from 22 data centers), the applications server (for support ESIMO portal), the main databases server (for support by the data ESIMO portal and an integration server), the standby DB server (for support of uninterrupted data access) and a control server (for provide support backup between the main BD server and the standby DB server). Now this work is in a testing stage.
Introduction data replication is necessary for maintenance in an actual state of the data on platform MCC, and as for reservation of a totality set of data NODS of Russia in storage. Date from the storage is supposed replication in a test DB with periodicity not less often than an once a day. Between platforms in Obninsk and Moscow bi directional replication only that part of the data that is necessary for support ESIMO portal with periodicity of times in half an hour is supposed. The total size of the used data makes an order of 12 Gb, the daily average traffic between databases no more than 200 MB.

In NODS of Russia a bottleneck is usage of the main DB server . The DB is applied not only users ESIMO portal, but applications developers. The big disadvantage is fact that in the course of testing by developers can be generated resource-intensive inquiries that reduces productivity of the preferred server and carries on to journalizing (to accumulation of the data in archive logs) superfluous operations and as calls deceleration of demand processing of the users query from portal. Therefore in the common infrastructure of hardware-software resources of centre foresaw the segment for an applications testing which includes a test DB which completely repeats structures and the data of the main DB and the test version of a portal.

One more perspective direction of optimization is development of data structures. Realize creation of uniform model of the metadata including more of 20 objects of the metadata (data on arrays and DB, organizations, formats of data storage, observant platforms, methods, instruments, parameters, etc.).
Operation in the directions designated above already has improvement of infrastructural interaction of technologies ESIMO. Discovering and removal of not used objects in DB has cast to simplification of understanding, search and service of the objects which are in DB. Data warehouse creation has united all data in a DBMS of one version on one platform that has lowered the common time and expenses for maintenance and administration. Construction of the distributed system and inclusion of the test unit in the common infrastructure ESIMO should raise speed operation of users ESIMO portal and lower risks at introduction of new technologies and an applications testing of developers. In this case the variant of construction of cluster technology, usage of the big powers, for example mainframes is possible.

ESIMO Service Bus as a unified tool to access the SOI ESIMO web-services

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Within the framework of the federal target program "World Ocean" the Unified Governmental System of Information on the State of the World Ocean (ESIMO) is created. The basic idea of ESIMO is creation of uniform distributed information space in the area of environment in World Ocean.

ESIMO infrastructure represents a difficult conglomerate of various applied systems. Complexity of applications integration limits possibilities of implementing flexible, dynamic infrastructure. This is integration based on principles of «strong coupling» when integration mechanisms bound to the integrated application code. Thus, changes in one application lead to the changes in other related applications. Another problem is the superfluity of software applications sometimes with the same functions and complexity of their reuse.

These problems could be solved by means of service-oriented architecture (SOA) that is attracting as a new approach for information systems being developed during last several years. This approach is based on services with standard interfaces. Within the framework of the ESIMO development and construction of the full-function system it is envisaged to develop ESIMO infrastructure based on SOA principles. Such infrastructure is called the ESIMO service-oriented infrastructure (SOI ESIMO). The SOI ESIMO represents aggregation of functional subsystems, information resources and technologies which interact throw the telecommunication instruments using technical specifications and web-services as a basis. Web-service is a standardized software application which functionality can be invoked throw the network.

Use of service-oriented approach while building full-function ESIMO will give access to marine environmental and marine activity data to various users. And also to organize remote call of methods, which process this data and work on the data provider side. Service orientation will expose data processing mechanisms to users while technical details of processing and internal logic of algorithms are hidden.

The core of the SOI ESIMO is the SOI ESIMO Service Bus. The SOI ESIMO Service Bus is the specific software which encapsulates ESIMO web-services and provides access to these services throw unified access point. Service bus provides interconnection between various ESIMO web-services throw unified interaction protocol. Services interact with each other not directly but through the services bus. Thus, ESIMO service bus acts as a gate between service bus clients and web-services which are connected and registered on service bus. Such approach provides great flexibility and simplicity of scaling and transportation. While replacing one service there is no necessity to replace services which are connected with it.

The SOI ESIMO Service Bus provides:

- web-service registration (web-services connection to the SOI ESIMO Service Bus);
- discovery of web-services and their methods;
- web-services invocation;
- web-services chaining;
- monitoring functions.

The SOI ESIMO Service Bus consists of three main elements: Service Registry, Methods Dictionary and Workflow Component.

Service Registry contains detailed descriptions of web-services and web-services methods which are connected to SOI ESIMO service bus. Usage frequency of web-services from Service Registry depends on web-service description completeness and clearness.

Methods Dictionary contains full information about web-services methods available throw service bus. When services interact with each other they don't know about each other existence. To interact they only need to know the unique method name from Methods Dictionary. Particularized service bus mechanisms redirect request to the required web-service guiding by unique method name. Thus, change of the name or location of one of the interacting services, replacing one of the interacting services do not influence to other related services. All necessary changes take place in the service bus and don't affect on related services.

Workflow component is the specialized software intended for process management.

The SOI ESIMO Service Bus interaction protocol includes transport level and applied level. On the transport level interaction with the Bus is implemented by SOAP protocol. On the applied level interaction with Service Bus is implemented by means of three operations exposed by service bus. These operations allow to search registered web-services methods exposed by service bus and to invoke them.

Thus SOI ESIMO service bus allows to withdraw from the standalone web-services, to implement and standardize methods and means of interface interaction. It also allows to unify access to services that belong to the various organizations and systems and based on different standards.

A new impetus to International initiatives in Seismic data dissemination: The opportunity of the EC FP7 Geo-Seas project.

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Several international initiatives addressing the issues of seismic data dissemination have taken place over the last 13 years. Although many similarities exist, most of them approached the problems from different perspectives which, at the moment, makes them non interoperable.

Among these we will consider the case of the EU funded SEISCAN & SEISCANX projects and of the Seismic data Library System (SDLS) from the Scientific Committee on Antarctic Research. These initiatives operated, and continue independently, reflecting the different priorities of various research communities. This is of course not the best way to proceed, since the development and “specialization” of scientific theories should be solidly grounded on shared, controlled and repeatable experiments. The risk of dividing instead of merging researchers is well understood by the EU commission, and this in part is the reason that the EC FP7 project Geo-Seas was funded. This project is designed to create a common data space that could gather all these initiatives under the same umbrella through the development of a common infrastructure. This would include all scientists involved in the field, and moreover, trigger cross fertilization between communities active in geology, geophysics and oceanography. In this view, analyzing the previous experiences of the above mentioned international initiatives, the project will review the peculiarities of the various seismic data types, and highlight how the Geo-Seas project will introduce a relevant step forward, especially from the perspective of the end user.

A changing landscape: The special case of the neighbouring BLACK SEA countries

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The project “Black Sea SCENE” (Black Sea Scientific Network) ran for 3 years from 1st December 2005 as a FP6 Research Infrastructures Coordination Action. It made a first step towards an integrated data management infrastructure for the marine research community in the Black Sea region. It successfully encouraged scientific cooperation and exchange of knowledge, expertise and environmental/socio-economic data & information. The project cooperated closely with the SeaDataNet infrastructure project, that started around the same time as an I3 project within the Research Infrastructures programme with a 5 years duration. A major objective of the Black Sea SCENE project was to stimulate the dissemination and to enable the uptake by Black Sea institutes of the data management standards and approaches of the SeaDataNet V0 infrastructure.

Within FP7 the project has been continued as ‘Upgrade Black Sea SCENE’ project for another 3 years till end 2011. The objectives are:

• To expand the existing network of regional institutes with an additional 19 marine environmental institutes and universities from the 6 Black Sea countries, bringing the total number of partners to 50 of which 41 from the Black Sea region; a

• To improve significantly the technical performance of the dat & information infrastructure by adopting and implementing the latest technical developments and standards of the Joint Research Activities of the SeaDataNet project:

- To implement the so-called V1 versions of all metadirectories (EDMED, EDMERP, CSR and EDIOS), which are now mutually harmonised, make use of Common Vocabularies and are based on ISO 19115

- To implement the V1 version of the CDI service with unified access to datasets and downloading services

• To enlarge the number of local data bases that will be made available for user access via the Black Sea SCENE infrastructure.

• To expand the existing metadatabases with additional entries from new partners.

• To assess the scientific data quality of the Black Sea partner’s datasets, through screening (Quality Control) of all data sets, to be executed by each Black Sea partner

• To implement innovative data visualisation and viewing techniques

• To prepare long term arrangements for sustaining the Black Sea SCENE network and the Black Sea distributed virtual data and information infrastructure

Partners Black Sea SCENE:
Mariene Informatie Service ‘MARIS’ (NL) with subcontractors EU-Consult, MT Consultancy and UNESCO – IODE (BE); International Bureau for Environmental Studies – (BE); Instytut Meteorologii i Gospodarki Wodnej (PL); Marine Sampling Holland (NL); Fieldfare International Ecological Development PLC (UK); Marine Hydrophysical Institute (UA); Ukrainian Scientific and Research Institute of Ecological Problems (UA)•Odessa National I.I. Mechnikov University (UA)•M V Lomonosov Moscow State University (RU)•P.P. Shirshov Institute of Oceanology of Russian Acadamy of Science (RU)•Institute of Limnology – Russian Academy of Science (RU)•Space Research Institute of Russian Academy of Science (RU)•All Russian Research Institute of Hydrometeorological Information – World Data Centre (RU)• Middle East Technical University-Institute of Marine Sciences (TR)• Sinop University Fisheries Faculty (TR)• Black Sea Technical University of Marine Sciences (TR)• Institute of Oceanology – Bulgarian Academy of Science BG)• Technical University Varna (BG)• Institute of

Fishing Resources S(BG)• National Institute for Marine Research and Development “GRIGORE ANTIPA” (RO)•National Institute of Marine Geology and Geoecology(RO)• Iv. Javakhishvili Tbilisi State University (GE)•The Centre for Monitoring and Prognostication of the Ministry of Environment Protection and Natural Resources of Georgia(GE)• M.Nodia Institute of Geophysics (GE)• Black Sea NGO Network (BG)•A.O. Kovalevskiy Institute of Biology of the Southern Seas (UA)• Hellenic National Oceanographic Data Centre - Hellenic Centre for Marine Research (EL)• State Oceanographic Institute (RU)• Georgian Institute of Hydrometeorology (GE)• Scientific Research Firm GAMMA (GE)• Georgian Water Management Institute (GE)•Taurida V.I. Vernadsky National University(UA)• Institute of Geological Sciences (UA)• Ukrainian Hydrometeorological Institute-marine branch (UA)• Southern Scientific Research Institute of Marine Fisheries and Oceanography (UA)•I Institute of Geo-Environmental Sciences (RU)• Center Dynamics of the Nearshore Zone (RU)• University of Mining & Geology-Geographical Institute (BG)• Central Laboratory of General Ecology-Department of Functional Ecology and Group of Water Ecosystems (BG)• National Institute of Meteorology and Hydrology (BG)• Danube Delta Biosphere Reserve Authority (RO)• Dokuz Eylül University-Institute of Marine Sciences and Technology (TR)• Istanbul University-Faculty of Fisheries and Institute of Marine Sciences (TR) • Ankara University-Faculty of Agriculture, Department of Fisheries (TR)• Balkan Environmental Association (EL)•Permanent Secretariat of the Commission on the protection of the Black Sea against pollution (TR)•Ukrainian Scientific Centre of Ecology of the Sea (UA)• Danube Hydro-meteorological Observatory (UA)• University of Cyprus-Oceanography Centre (CY)

Marine Spatial Data Infrastructure: GIS for a Blue Planet

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Geographic information systems (GIS) have had a dramatic impact on how spatial information is produced and used in different domains. Current technologies enable spatial analysis and the creation of all kinds of mapping and charting products from seamless databases, merging data from different sources, including temporal analysis. The problem comes when trying to share this information across different organizations or even to be accessed by the common people in their day to day work. GIS is not exclusive to the GIS professional anymore, everyday more people require spatial data or products to plan, make decisions, put more information in it or just to go from point A to point B.

Spatial data infrastructures (SDIs) enable access to spatial data; nowadays several national governments around the world realize the importance of SDIs to maximize this access; clear examples of that is the multinational Infrastructure for Spatial Information in Europe (INSPIRE).

But meanwhile land SDIs are already developing and many books talk about SDI as a whole, the Marine world is now running to this area, trying to understand what's this all about and realizing how important and unique it is in this environment. International bodies like the International Hydrographic Organization (IHO) are now promoting the development of a Marine SDI among its member states and with the recently approved new Universal Hydrographic Data Model S-100, a whole new horizon of opportunities for data sharing and merging is opening up.

This paper describes the importance of a Marine SDI today, what considerations need to be taken to develop one, what tools could be used to do it and what could be expected in the future based on new standards.

The development of the seamounts relief metadata standart

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The integration of the WEB and Geographic Information Science (GIS) has recently led to development of new forms of geo-representations. Currently, many geospatial solutions are WEB-based and provide access to distributed services in order to support specific application domains. For a well regulated keeping of the factual data about seamounts relief the creation of modern information system is necessary.

The elaboration of the INTERNET metadata reflected the logic structure and the since of preserved information is the important stage of the information system's creation. We suggest to creating the seamounts morphological signs classification and the metadata's standard on the basis of geographic information modeling and analysis. The elaboration of thematic standard of the seamounts relief's metadata is oriented on the composition of the most complete and laconic characteristic of object.

Recently we observed in the INTERNET Seamount Biogeoscience Network (SBN) (http://earth.ref.org/SBN), Seamount Online (http://seamounts.sdsc.edu). These information systems (IS) used only local bathymetry map of individual seamount with a different scale now. But recently in the last version of GEBCO map -30'' relief (http://www.gebco.net/) can be used directly for measurement and calculation characteristic of the seamounts directly.

The presented structure of the specialized IS unite the morphological, geological and geophysical information about individual seamounts obtained in bathymetric and altimetric study of the ocean bottom, in the research and deep-sea drilling cruises, in special literature about geosciences and ocean science exploration and research.

For INTERNET with a lot of GIS-map materials usually used as library of maps. This block of information system a standard ISO 19115. Such technology takes us possibility to combine maps with different features and in scales for our area researches.

As digitals maps and grid data usually used various the software of management of database - from MY-SQL to ORACLE, integrated with GIS and special servers' type as ARC-IMS (ESRI) or MapServer (Minnesota University) (http://mapserver.gis.umd.edu).

Multimedia cartography is the combination of maps. A multimedia map combines cartographic entities with different types of features, such as text, grid, 3D animation, etc., and may to lead to more realistic representations of the initial data. Defining interaction with users as the key to knowledge formation, multimedia cartography is the interaction with maps supported by multiple forms of users interface.

Our problems now to create program software enabling us to calculate parameters of geomorphology of seamounts on the basis of GIS maps directly by user's interactive WEB-interface.

Except the standard signs about the name, the geographic location and the bathymetry the seamount's description of full value requires a number of morphologic data.

The seamount shape and the bottom's structure the seamount is found within are indicated in text after The Standardization of Undersea Feature Names (Monaco: International Hydrographic Bureau, 2002).

Morphometric characteristic include the notes about seamount height in meters; basis areas in square meters; basis extension indicated the seamount basis width/length ratio in unit's part; basis azimuth in degrees. This information is means for the formalization of the seamounts morphostructural analyze and its development.

Besides the seamount age in million years and the underlying plate age in millions years we propose to indicate some characteristics of modern eruptions: age of volcano in thousands years and them activity type in text.

Enumeration of geological and geophysical studies carried out on seamount (such as: the multibeam bathymetry, satellite altimetry, side scanning, single-beam sounding, long geophysical record, gravimetry, magnetometry, geothermy, deep-sea drilling, dredged, photographs and video films, submersibles, et al.) is it. This enumeration serve to the contacts with the existed thematically IS arrangement and to the different investigations results utilization. The resolution of the metadata standard problem is necessary for it.

We indicate the ore's formations in text. The ferromanganese nodules, the ferromanganese crusts, the phosphates, the sulfides are developed on the seamounts surface, for example.

The post volcanic transformation of island's relief is show in the erosion-abrasion terraces and landslides formation. The characteristic of the terrace include: terrace depth about the sea level in meters; terrace age in millions years; terrace width in meters; terrace highly in meters. These data are interesting for geomorphic and paleooceanologic reconstructions. The parameters of landslides are: landslide type in text and landslide size in square meters. We include this field in Database as the landslides are widely developed on the seamount's slopes. The debris avalanches evoke the terrible wave of tsunami sometimes.

The Database's information is necessary for the of full value description of the seamounts relief and its historical-genetic analysis. The accessibility of the information and the interesting data choice for the conduction of the quantitative analyze augments the variety and the reliability of conducted investigations.

Linking data from the point of sample collection in the field using barcoding systems: The case of the Tara-Oceans initiative

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There is a general tendency during field work and laboratory work to either not measure ancillary data such as temperature, salinity or irradiance, or to store them separately from primary data, often written by hand in lab books or on proprietary computers. The most basic contextual data such as latitude, longitude, date and time are sometimes not recorded, depending on the object of study. In multidisciplinary studies, samples are split among several teams that run a number of analyses leading to dispersed, but yet related aliquots and datasets. Unfortunately these are difficult to link a posteriori. In the end, only a fraction of the original data is published, often spread in several paper and electronic publications which cannot be integrated without major efforts in text recognition and data mining.

Tara-Oceans is the new expedition of the 36 metre schooner Tara that set sail from France in September 2009. The three-year expedition (http://oceans.taraexpeditions.org/) is exploring the world oceans to determine global plankton genomics, systematics, morphology, biogeochemistry and related environmental data. The multidisciplinary team covers all plankton organisms from viruses, giruses, bacteria, protists, mesozooplankton to fish larvae, and a range of physical and biogeochemical measurements. The legacy of the project will comprise scientific publications, books, large public media products and educational products, all of which will be based on Tara-Oceans data and Tara-Oceans data products, i.e. aggregated and pre-treated data. The success of the initiative thus depends on quality data management.

We present here the data management scheme that is developed as part of Tara-Oceans to (1) barcode the aliquots that are distributed to and analysed by Institutes across Europe and North-America, and (2) later assemble genomics, biodiversity, biogeochemical and environmental data that are distributed in specialised data archives.

Session 4 - Education in Ocean science

Oral presentations

The OceanTeacher Academy: training in support of marine data and information management worldwide.

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With the establishment of the OceanTeacher Academy (OTA) a facility has been created that will provide an annual teaching programme of courses related to oceanographic data and information management and the development of related products and services.
OTA will contribute to the sustainable management of oceans and coastal areas in Africa and other regions and it will underpin all Ocean Data and Information Networks (ODINs) developed by IOC/IODE (The International Data end Information Exchange Programme of the Intergovernmental Oceanographic Commission).

The main part of the training activities are organized at the UNESCO/IOC Project Office for IODE but the development of regional training nodes will also be promoted thereby providing a multiplier effect on the number of trainees as well as a contribution to the long-term impact of capacity building of IOC/IODE and other IOC programmes. The OTA concept consists of a regular cycle of standardized courses on oceanographic data and information management. OTA contributes to the building of high-quality and up-to-date expertise in national oceanographic data centres (NODCs), marine information centres (libraries) and related facilities. OTA also enables staff of NODCs to become up to date with the latest methodological and technical developments (continuous professional development). OTA targets university students and marine scientists in order to create awareness of the importance of oceanographic data management and marine information management among these groups. A special curriculum has been developed for this purpose.

Trainees can participate either self-funded or by applying for OTA sponsorships. The approval process takes into account the FAO's LIFDC (Low-Income Food-Deficit) status of the candidate's country, the expected added value for the home institution and the availability of co-sponsorship.

The offered courses are based upon training priorities in the marine data and information community, which were assessed by means of a survey. A programme of 9 courses is proposed for 2010 (see course calendar, http://www.oceanteacher.org). Priorities for oceanographic data management include Marine GIS, Coastal Atlases and Basic Oceanographic Data Management.

A special training course for young scientists (September 2010) will be aimed at the whole data process (from sampling to data products) and will include a research cruise. Marine Information Management training activities will focus on specialized topics such as Preservation and Archiving of Digital Media, Grant Writing and Specialized Marine Literature.

OceanTeacher is the training tool and consists of the Digital Library, an open archive of resource articles and documents based upon MediaWiki software, and Courses, containing the courses on marine data and information management and based upon the Moodle software platform. The OceanTeacher Academy is funded by the Government of Flanders through FUST (Flanders-UNESCO Science Trust Fund).

UNEP/GRID-Arendal's Marine Data and Information Management Systems: Meeting the needs of developing states

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May 2009 saw the first major milestone for the submission of documents in relation to Article 76 of the United Nations Convention on the Law of the Sea. All states required to meet this deadline provided the necessary documentation to, in the least, outline their area of interest for the delineation of the outer limits of the continental shelf. The key challenge for states still working towards a final, full submission remains the collection and interpretation of scientific evidence needed to support their conclusions. Countries with the means to develop large scale initiatives have invested many resources into getting the job done. Developing states and small island developing states (SIDS), however, face great challenges in addressing this issue as many lack the institutional and financial capacity so readily available to richer nations.

The UNEP Shelf Programme (USP), coordinated by UNEP/GRID-Arendal, is the access point to a collaboration of international organisations with expertise in marine geosciences and maritime law. It was established in response to a United Nations resolution, calling on the United Nations Environment Programme (UNEP), in conjunction with other UN agencies to develop a system to store and handle research data from the outer continental margin, with a view to serving the needs of coastal States, and in particular developing countries and small island developing States, in their compliance with article 76 of the Convention. A One Stop Data Shop (OSDS) has progressively evolved since the inception of the USP to its current regrouping of inventory from 14 of the world's biggest public marine geoscientific institutions. Since the 2008 IMDIS, the USP, via the One Stop Data Shop, has facilitated access to vital historical marine data to nearly 30 developing coastal states and small island developing states in Africa, the South Pacific, Latin American and Southeast Asia. The USP also strives build up the technical capacities of national teams by organizing multistate training workshops targeting large regions.

As developing coastal states and SIDS transit from delineating the outer limits of the continental shelf to managing this new deep sea territory, UNEP/GRID-Arendal is building upon the success of the OSDS both in assembling an impressive partnership of data providers and in catering to the needs of developing states working towards a specific goal. Sound management and sustainable development of the deep sea environment is initially dependent on access to, and the capacity to use and understand, multidisciplinary marine data.

A global marine resource and information database (GmRID) seeks to grow the partnership of the OSDS beyond the primarily marine geological and geophysical themes, to include all major types of marine data inventories that are required for spatial planning, marine protection and resource management by developing states and small island developing states. By facilitating access to marine scientific data held by international institutions, and by building the capacities of national experts, UNEP/GRID-Arendal, in conjunction with other major capacity and data providing agencies, seeks to 1) ensure that developing states have the abilities and information necessary to make their own, independent marine management decisions and 2) that the vast volumes of available marine scientific data are used to their full potential by all stakeholders.

New Type of the Ocean Data Management Training for Young Scientists: from Measurement to Product

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Our experience in working with young oceanographers and ocean data managers shows that oceanographers very often have only limited knowledge about data formatting, quality control, storage, back-up, database management, etc. At the same time, the data managers have limited knowledge on the measurement process, quality assurance, metadata compiling, etc. This leads sometimes to systematic errors in data processing and prevents detection of errors in data sets.

For these reasons, the idea was born to organize a new type of training for young scientists that will cover the full process of data generation and processing from cruise preparation (instrument calibration and so on) to the generation of final data products (maps, statistics, graphics and reports, etc.). A cooperative effort between the Flanders Marine Institute (VLIZ) and the IOC Project Office for IODE, co-located in Oostende (Belgium), created excellent conditions for the organisation of such a training event, uniting VLIZ -- with its research vessel “Zeeleeuw” and qualified research staff -- and the Project Office with its professional trainers and special facilities for organizing the training itself.

The trial version of this innovative training was held in June, 2007. The training was based on a special draft training course, “Ocean Data Management for Young Scientists,” published in OceanTeacher – the main IOC/IODE online training resource (http://oceanteacher.org). The course included the following sequential lessons:

- Introduction to the OceanTeacher
- Oceanographic Parameters
- Oceanographic Measurement Units
- Oceanographic Data Formats
- Oceanographic Instruments
- Overview of Southern North Sea Hydrography
- Building an Historical Data Collection
- Basic Data Products
- Pre-Cruise Briefing
- At-Sea Practicals
- CTD (Sea-Bird) Data Processing to HDR + ASC Formats
- CTD Data (HDR + ASC) Addition to Historical Data Collection
- Cruise Metadata & Documentation

15 young scientists from 15 countries around the world (Europe, Middle East, Asia, Africa, South America) took part in this course. The VLIZ Research Vessel “Zeeleeuw” was used to support the training activity. The duration of the course was 5 days, including a one day research cruise on the board of the R/V Zeeleeuw. A presentation workshop was organized at the end of the course, for which the students were asked to create short PowerPoint presentations (to include graphics from Ocean Data View) of the data that were collected during the one day research cruise on the North Sea.

According to a survey of the participants, assessing the value and quality of the course, the training program proved to be very successful. In the survey the trainees “agreed” or “strongly agreed” with the

statement that the training was useful for them and their institutes, and the main remark was that the course was too short, so that future such courses should be longer and should cover more related issues. We propose therefore that a new, updated version of such Ocean Data Management Training Course will be developed and organized in 2010 jointly by the IOC Project Office for IODE and VLIZ.

Animated 3D Tracer Distributions for Ocean Education

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With the growing awareness of the great impact of the ocean on our environment and changing climate it is becoming increasingly important to teach ocean sciences not only to the specialists in the field but also to a broad range of other, non-oceanographic disciplines, to decision makers in politics and industry, and to interested layman and the general public. What needs to be conveyed is our understanding on how the ocean functions, and also how important properties, such as heat, carbon and oxygen, are distributed geographically and with depth. For the latter purpose, animated 3D distributions can be of great help, as they contain and reflect a large amount of information based on comprehensive data compilations, yet, these products are intuitive and easily understood, even by non-specialists. In the talk I present 3D animations of anthropogenic carbon, oxygen and other tracers in different parts of the world ocean. The software, Ocean3D, that creates these animations is based on OpenGL and uses realistic bathymetry and coastline data. Ocean3D interfaces with Ocean Data View, and the data shown in the 3D views are extracted from ODV data collections.

Consilience on the beach: inquiry-based educational programs on sandy beaches

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It is widely accepted that the interest in science among Europeans is declining. This decline is responsible for difficulties in making decisions based on the scientific knowledge and a gap between research, policymaking and social awareness. The resulting confusion between science and junk science and pseudoscience (astronomy vs. astrology, medicine vs. homeopathy, protection of the environment vs. knee-jerk reactions) can be dangerous for the democracy. We believe that an appropriate information strategy and education patterns can increase the social awareness of the marine environmental issues that will bring forward desirable actions and policies. The way to achieve this goal is, in our opinion, to engage marine scientists in the teaching process and to involve them in the programs that educate through research. We have tested this approach by formulating three education programs that were based on close cooperation with schools and on participation of high school students in relatively simple but time-demanding (in terms of frequency and continuity) environmental observations.

Our out-of-school education program was focused at the sandy beaches of the Polish coast. In total, three educational programs were developed. The goal of the first program was to involve the students in time-demanding measurements of various biological (macro-detritus, macrofauna, nekton, fauna in the algal mats) and physical data (including water transparency, sea surface temperature, pH, salinity and meteorological data) of the selected sandy beaches in Gdynia, close to the location of the high school involved. All the measurement procedures were designed to be easily accomplished by groups of 2 to 5 students using simple equipment available at every school. The student volunteers were trained by the marine scientists, who travelled to the school to present the theoretical background of the biological problem and the theoretical basis of the research techniques necessary to address it. Data collecting procedures and data processing were also discussed. The marine scientists were helped by students' biology teacher who then supervised the field work. The theoretical instruction was followed by an introductory field trip during which the measurement techniques were demonstrated on the beach. One time presentation was found to be enough for the students to master the procedures. The volunteer groups visited the selected sites at least once a month. Four groups of students completed the measurements throughout the duration of the experiment (two years).

In another program developed in parallel to the one described above, the students themselves had to plan an experiment or a field study with the help and supervision of professional marine scientists. Each study was designed to be methodologically easy, but to address a bona fide scientific question. For example, one of the field studies involved finding out if the river bank is as efficient as the marine beach in organic matter consumption, and another student aimed to find out how deep in the sand meiofauna organisms are living (the strata below 1.5m were reached, followed by species identification and count). To provide two other examples, in a project entitled: “Drifting algal mats: are they a raft for macrofauna or a deadly carpet?”, the students counted dead and alive macroorganisms in the algal mats (over 50 samples were analysed) and in the project entitled “What is the reaction of meiofauna to the discharge of salt to Baltic water?”, the students were observing the escape reactions of meiofauna at different salt concentrations. This experiment was motivated by the plan to discharge huge amounts of salt brine in the Puck Bay. All the projects centered around the sandy shore function

as an ecosystem. During almost 10 years (2000-2009) of the program, over 30 independent projects were run, and the results were presented by the students in a national competition for student research project (Biological Olympics), with some reaching the top scores.

The third educational program was centered around one day long field campaigns. The goal was to check the presence of sandhoppers along the Polish coast. Sandhoppers (Talitrus saltator) are small crustaceans that bury in the sand during the day and actively search for food at night. The field work protocol included simple actions such as digging holes of the specified size and depth, removing the upper sand layer and counting the jumping-out sandhoppers. The students received theoretical introduction in the schools and the practical instructions during the field trip. Here also the protocol was easy enough to be mastered after one time demonstration. However, the biology teachers and marine ecologists were present on site all the time during the data collecting, providing assistance when required. The program continued during 6 years and covered the whole Polish coastline. Once per year (May) large group of school students (over 100) was invited for a field excursion on the Hel Peninsula, during which they walked along 10 km of the beach, digging holes in the. Every walk in the sandhopper inventory program resulted in 3000-4000 sampling points (holes) and provided detailed information about the distribution of this endangered sandy shore animal.

In all the programs described above, the students were given the possibility to analyze the data, create the web pages presenting data, methods, results and conclusions. Some even created on-line experiment diaries.

The experience gathered in the above programs was shared with the participants of the Spring School on Coastal Monitoring which was held in CiMar in Porto (Portugal) in March 2009. The Spring School brought together marine scientists, teachers and students from Portugal, Greece, UK and Poland (http://www.marlin.ac.uk/porto/surveys.php). All the participants were involved in a number of surveys and investigations during the School and could share their experiences from local case studies. The School concluded with the proposal of creating the European Education Marine Monitoring Network and the proposal to involve teachers of humanity subjects (especially art and language teachers) in the programs aimed to promote the involvement of students in scientific research and in international cooperation between young European students-scientists. The humanity teachers could be also encouraged to incorporate the issues concerning biodiversity and science in general in their own curriculum.

We believe that such broadening of curriculum could be also possible with the teachers of other school subjects. One example is computer science teachers. Advanced technologies and eLearning methods can be easily linked with environmental research, and the multimedia materials created by the students and then disseminated by electronic communication channels could increase the impact of the educational programs. Student-created material can complement the educational multimedia produced by the teachers and researchers, using formats similar to Youtube. In fact, this particular platform can be easily adopted for such a purpose and used to broaden the target audience. Development of such material is part of existing projects run in our institutions (for example, EUROFLEETS and the project to create the Integrated System for Oceanographic Data Processing).

In our opinion, marine science projects have a potential to demonstrate the continuity of science and humanities: consilience in terms of E. O. Wilson. Marine science is a highly interdisciplinary field, which can be reflected in the educational programs that allow to integrate and use the knowledge otherwise presented in separate school subjects: physics, chemistry, biology, geography, mathematics, economy, computer science, art and language. It has high impact on every day life, and a practical appeal that can be easily appreciated by even the youngest students who simply enjoy the beach. Students can be easily trained to start from simple procedures and then progress to more advanced methods, including assessment of microbiological and toxicological safety of the beach. We are now involved in formulating educational programs that will involve such highly integrative approaches, programs that will involve not only high school students but also younger children.

In all the educational programs we have developed thus far, the inquiry-based approaches received positive feedback from the teachers involved. The cooperation between the marine scientists and the schools is still being maintained and further developed. The results of the sandhooper study allowed preparation of two manuscripts (one of which is already published: Weslawski et al. 2000. Oceanological Studies 29, 77–87).

However, very little is known, if anything at all, about the social experience gained by the students. We believe that it is of high interest to actually investigate in a quantitative manner if inquiry based educational programs such as the programs described above can shape personal attitudes towards science in general and the marine environment in particular. These attitudes (or subjective values) are derived from individual preferences influenced by occupation, interests, stereotypes and symbols. Whether they can be influenced by the students' experience with problems and methods of marine environmental science remains to be seen. Perhaps even more importantly, it is of high interest to assess if such educational programs can affect the ability of the students to take decisions based on the critical assessment of available data, and possibly lead to an increase of the scientific culture in the society.

Session 5 - Round table on Future prospective on linking distributed marine data systems

Oral presentations

Data Management Expectations from OceanObs'09

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OceanObs'09 took place in Venice 21-25 September 2009. This was the second conference, a decade after the first (OceanObs'99), to review the state of the ocean observing system and to look ahead for what is needed and what is possible. It brought together more than 600 participants from 36 countries. The ocean community was asked to submit community white papers on all aspects of the observing system. A few of these focused on data management, and many others touched on data management issues. Data management was also the subject of four plenary papers reviewing the current state of ocean data management and identifying weaknesses that needed attention. They also acted as the summary and consolidation of the ideas found in the community white papers and from the experience of the plenary paper authors. The last of the plenary papers, presented a vision for the future suggesting technologies and strategies that looked to be useful to pursue. All these plenary (and white) papers will appear in the conference proceedings later in 2010 and can then be read for greater detail. This paper will summarize the results to indicate the expectations of the ocean community towards a global ocean data system, and to present the possible solutions that could be implemented. The data management community needs to take these into consideration and to choose implementation strategies that achieve community expectations.

Integration of Marine Meteorological and Oceanographic Observations into the WMO Integrated Global Observing System (WIGOS)

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Improved access to consistent, coherent, and traceable oceanographic and atmospheric data from diverse sources is critical to address global concerns and issues. Efforts to improve seamless, timely, and open access to integrated data and products will be provided by WMO and its partner International Organizations through the WMO Integrated Global Observing System (WIGOS). The central goal is to provide a comprehensive, coordinated, cost-effective and sustainable global observing system that integrates diverse surface and space-based observations to make available data and services that benefit society through WMO Programmes and Co-sponsored Programmes. WIGOS will enhance coordination of WMO observing systems with those of partner organizations, and the WMO collaboration with those partners. A key requirement for integration within WIGOS is for harmonization of standards in three key areas - instruments and methods of observation, data management infrastructure, and end-product quality assurance.

The Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) is contributing to the development of WIGOS though the implementation of the JCOMM Pilot Project for WIGOS. The Pilot Project is an interdisciplinary exercise to investigate the integration of in-situ and space based ocean observing systems collected within the oceanographic community. The aim of the Pilot Project is to integrate marine meteorological and oceanographic observations (in situ, surface marine, and satellite data), real time and delayed mode data and products (e.g. models) collected within the oceanographic community. The Pilot Project is considering instruments and methods of observation aspects, as well as data management, data exchange, and quality management.

The key deliverables are to document and integrate instrument best practices and related standards, including the establishment of regional or specialized marine instrument centres, to build interoperability between marine data systems, and in particular the IODE Ocean Data Portal (ODP), and the WMO Information System (WIS), and to promote quality management and standards which will result in the availability of quality data to meet the requirements of a broad and varied community of users.

This paper outlines the benefits of WIGOS integration of oceanographic observations for data users and discusses the achievements of the Pilot Project.

Authors Index

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

V

W

Y

Z